DOCUMENT RESUME

ED 207 268 EC 133 579

AUTHOR Ashcroft, S. C.
TITLE Evaluation and Research Program for the Portable Braille Recorder (PBR). Volume II. Appendices to Final Report.
INSTITUTION George Peabody Coll. for Teachers, Nashville, Tenn. Dept. of Special Education.
SPONS AGENCY Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C. Media Services and Captioned Films Branch.
BUREAU NO BEH-AH-70171
PUB DATE Sep 79
NOTE 180p.

EDRS PRICE MF01/PC08 Plus Postage.
DESCRIPTORS Audiotape Recorders; *Blindness; *Braille; Check Lists; *Electromechanical Aids; Equipment Evaluation; Reading Materials; Records (Forms); *Sensory Aids
IDENTIFIERS *Portable Braille Recorder

ABSTRACT

The document makes up the appendixes to the final report of a program to evaluate user satisfaction, practicality, reliability, and maintainability of the Digicassette (or Portable Braille Recorder--PBR), an electronic braille reading and writing machine and an audiotape recorder which is compact and easy to carry around. Materials include the following: sample survey interview forms; participant case studies; a checklist for evaluating braille equipment; PBR research program rating scale; verbatim transcripts of student comments; log of equipment malfunctions; sample reading materials for children and adults; sample writing materials for children and adults; reading behavior observation and factors present in oral reading forms; J. Snowden's computer procedures; a paper titled "Discussion--Experiences with ELINFA's Digicassette Research, Educational, and Employment Settings" by S. Ashcroft and M. Bourgeois; Association for the Education of the Visually Handicapped presentation paper; special education technology presentation paper; Council for Exceptional Children presentation paper; and criterion referenced proficiency test. (SB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED207268

Volume II

Appendices to

Final Report

Project No. BEH-AH-70171

Evaluation and Research Program for the Portable Braille Recorder (PBR)

S. C. Ashcroft, Principal Investigator

Faculty of Special Education
George Peabody College for Teachers
of Vanderbilt University
Nashville, Tennessee 37203

This document was prepared pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express their judgment freely in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Bureau of Education for the Handicapped
Division of Media Services

EC133579

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

✓ This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

APPENDICES

1 Survey Interview Form. 1

2 Participant Case Studies 6

3 Checklist for Evaluating Braille Equipment 34

4 PBR Research Program Rating Scale. 37

5 Verbatim Transcripts of Student Comments 39

6 Log of Equipment Malfunctions. 56

7 Sample Reading Materails - Children. 58

8 Sample Reading Materials - Adult 65

9 Sample Writing Materials - Children. 70

10 Sample Writing Materials - Adult 76

11 Reading Behavior Observation and Factors Present in Oral Reading forms 79

12 John Snowden's Computer Procedures 83

13 Computer Tape Translation Procedures and Programs. 101

14 Paper submitted to Journal of Visual Impairment and Blindness, based on conference call 110

15 Association for the Education of the Visually Handicapped Presentation Paper. 126

16 Special Education Technology Presentation Paper. 142

17 Council for Exceptional Children Presentation Paper. . . . 158

18 Criterion-Reference Proficiency Test 174

19 Volume III - Digicassette Operating Manual . . . . . .

APPENDIX I

Survey Interview Form

PORTABLE BRAILLE RECORDER RESEARCH

SURVEY INTERVIEW

PERSONAL HISTORY

1. Name: _____
Last First Middle Initial

2. Address: _____
Street City Zip Code

3. Sex: _____ _____ (Check One)
M F

4. Birth Date: _____

5. School Attending: _____

6. Present Grade in School: _____

7. Number of years in special class for Visually Impaired: _____

8. Degree of Vision: None _____ L.P. _____

F.P. _____ Partially Sighted _____

9. Specify any other handicapping conditions: _____

_____

_____

_____

READING HISTORY

1. Has braille been your only mode of reading? yes_____ no _____

2. When did you begin reading braille? _____

   a. Kindergarten
   b. 1st grade
   c. 2nd grade
   d. Other (Specify)_____

   _____

   _____

3. How did you begin learning braille? _____

   a. With the braille alphabet
   b. With whole words
   c. With meaningful sentences
   d. Other (Specify)_____

   _____

   _____

4. What grade of braille did you use in beginning reading? _____

   a. Braille Grade 2 (fully contracted braille)
   b. Braille Grade 1-1/2 (slightly contracted braille)
   c. Braille Grade 1 (full spelling)

5. If you did not begin with Braille Grade 2, when were you introduced to it? _____

   _____

6. Who provided your initial instruction in braille?

   A. For residential schools: _____

      a. The classroom teacher
      b. A special braille instructor
      c. Other (Specify) _____

      _____

B. For local day school programs: _____

a. The resource teacher
b. The itinerant teacher
c. The classroom teacher in a special class
d. The regular classroom teacher
e. A special braille teacher
f. Other (Specify) _____

_____

7. Do you read both inkprint and braille? yes _____ no _____

8. Have you changed from inkprint to braille? yes _____ no _____

Specify grade: _____

9. What is the name of the reading series you are presently using?

_____

10. What supplementary materials, such as workbooks, are you using?

_____

_____

_____

11. When were your reading books, including pre-primers, introduced to you? _____

a. At the beginning of braille reading instruction
b. After words or sentences are read
c. Other (Specify) _____

_____

12. Is your reading instruction primarily conducted by: _____

a. Oral reading
b. Silent reading
c. Both

13. Outside of the classroom, do you read: _____

    a. Avidly (a lot)
    b. Occasionally
    c. Rarely
    d. Never

14. What kinds of materials do you read outside of the classroom? _____

    a. Books
    b. Magazines
    c. Other (Specify) _____

    _____

15. Outside of the classroom, do you: _____

    a. Listen to talking books
    b. Read any large type materials

READING MECHANICS

1. With which hand do you read? _____

    a. With the right hand
    b. With the left hand
    c. Either hand
    d. With both hands

2. Does it matter which hand you use in your program? yes _____ no _____

3. If you use both hands, do you: _____

    a. Use the left hand to find the next line
    b. Use the right hand to find the next line
    c. Read next line with left hand before finishing preceding line with right hand
    d. Read next line with right hand before finishing preceding line with left hand

4. Which fingers do you use in reading? (Circle)

Left Hand				Right Hand			
4	3	2	1	1	2	3	4

5. How do you hold your braille book when you are reading? _____

   a. Approximately parallel to the body
   b. Slanted to the right
   c. Slanted to the left
   d. On lap, even though reading at a desk
   e. Other (Specify) _____

   _____

6. When did you first learn to write braille? _____

   a. At the same time as reading
   b. After some reading skill was developed
   c. Second grade
   d. Third grade
   e. Other (Specify) _____

   _____

Appendix 2

Participant Case Studies

Child #1 - Ohio

Subject number one was a young girl, nine years old, who attended one of the local public elementary schools. She was a third grader who had spent six years in classes for the visually impaired. Her degree of vision has been cited as light perception.

Braille was her only mode of reading, and instruction began in preschool. She began learning braille through the use of the braille alphabet and learned grade two braille. Her initial instruction in braille was provided by the classroom teacher.

She reads braille books occasionally and enjoys listening to talking books outside of the classroom. In the classroom, braille is her mode of reading; she reads no inkprint. When reading braille, she generally reads with her right hand and her index finger with the book parallel to her body.

She appeared to be a student of average ability but with a great deal of independence. She also seemed to be very responsible.

Braille reading speed when reading conventional braille and the PBR was calculated on six separate passages of appropriate graded difficulty. Her reading speeds on the three conventional braille passages were calculated as 20.8, 27 and 32.3 words per minute and 15, 13.3 and 26.5 for PBR reading. Following a time period of using the PBR, her rates were again calculated. Her reading rate for conventional braille was 27, 25.5 and 30.3, and for the PBR, her rates were 21.8, 14.3 and 33.7. Average reading rates were 26.7 for pre conventional and 18126 for pre PBR; post rates were 27.61 for conventional and 16.61 for the PBR.

Error rate for each passage was also calculated. For the pre-conventional passages, errors per minutes were 4, 3.8, and 3.3 with an average being 3.7. For the pre- PBR passages the errors were 3.6, 2.8, and 3.6 per minute, averaging to 3.3. The post test errors were as follows: conventional passage errors per minute were 2.5, .67, and .33 with an average of 1.17. PBR passage errors were 2.33, 1.83, and 3.83 per minute. The average was 2.66.

Braille writing was calculated by dictating passages of appropriate graded difficulty on both the Perkins Brailler and the PBR. The preconventional passage was written at 12.33 words per minute. Error rate is not available for this passage. The pre-PBR writing rate was 12.07 words per minute with errors being 1.85 per minute. Fro the post test, this sutdent wrote 15.70 words per minute on the Perkins Braille with 1.58 errors per minute. On the PBR, the rate was 13.74 words per minute. Data are not available for the error rate.

In summary, this third grade girl was moderately satisfied with the PBR. She had difficulty with the weight of the machine and the touch switch was difficult for her to adapt to. Her average reading rate for the PBR was lower than conventional braille for both pre and post evaluation. Error rate for the initial evaluation was lower for PBR reading and only slightly higher for PBR on the post evaluation. Her writing rate was quite similar with both the PBR and conventional braille; the PBR was only slightly slower. This young girl had some difficulty with adapting to the PBR; perhaps a longer training period for accommodation would have been helpful.

Child #2 - Ohio

Subject number 2 was a sixth grade girl in the Columbus Public Schools who had been in classes for the visually impaired for five years. She has no vision and braille is her only mode of reading.

She began reading braille in the first grade by learning the braille alphabet. Grade two, fully contracted braille was the type of braille she began reading. She received instruction from a classroom teacher in a special class.

Outside of the classroom, she is an avid reader, reading both braille books and magazines. She does not listen to talking books.

Her braille reading mechanics may be classified as reading with both hands, using all fingers. She uses the left hand to find the next line. Generally, she reads with the braille book on her lap or at a desk.

She appeared to be a student with above average ability; this was also her classroom teacher's opinion. She worked independently most of the time and did very good work.

Braille reading speed was calculated in words per minute. Different passages were written for the posttest. For conventional, this student wrote 18.05 words per minute, errors being 1.36 per minute. Writing rate for post PBR was 25.28 per minute. Error rate is not available for this passage.

Results of the Evaluation and Research Program for the Portable Braille Recorder for this subject indicate a high satisfaction and accommodation to the PBR. She had one of the highest rates of all of the subjects for reading. It was, however, not as good as her

reading rate on conventional braille. Error rate for both the pre and post was better on conventional braille reading. The error rate did, however, improve over time as indicated by the posttest.

Writing on the PBR was done equally well to writing rate on a Perkins Brailler for the pre test. For the posttest, writing rate was better on the PBR. Error rate was equally well for both the pre and the posttests.

Child #3 - Ohio

Subject number three was a fourteen year old girl in the eighth grade at one of the public junior high schools. She had attended a special class for the visually impaired for nine years.

She had light perception and color perception. If letters were printed clear and large, she could read one letter at a time. Even though she has this ability, braille is her only mode of reading.

She began reading braille in the first grade by learning the braille alphabet. Her classroom teacher, in a special class, began teaching her grade one, full spelling braille.

Outside of the classroom, she reads a great deal. Her sources of reading materials were braille books and magazines.

Her reading mechanics involve reading with her right hand and right index finger. Generally, she reads with the book parallel to her body and on her lap.

She appeared to be a student of average academic ability but exceptional warmth and outgoingness.

Braille reading rates were collected for reading in both conventional and PBR reading. Initially, her conventional braille reading rates were 140.6, 135.5, and 128.3 words per minute, and her PBR reading rates were only available for one passage and that rate was 27.6 words per minute. After training and practice with the PBR, reading rates were again collected for comparison. Her rates on conventional braille were 122.8, 149, and 145 words per minute. Her rates using the PBR were 66.3, 75.7, and 69.3 words per minute. Average words per minute were 134.8 for pre-conventional, rates for

pre-PBR were missing; post rates were 138.94 for conventional and 70.44 for PBR reading.

Error rates were calculated for the reading passages in both conventional and PBR. This student's errors per minute on the pre-conventional passages were 3.3, 2.5, and 3.6 with the average being 3.7 per minute. Pre-PBR error rates were only available for one passage and that rate was 2.1. After training and use of the PBR, reading passages were again given to draw comparisons. The posttest errors per minute on conventional braille were 1.33, .5, and .33. The average was .72. The posttest errors per minute on the PBR were .33, 1.33, and 6.83. The average was 2.83.

Comparisons were also made in writing braille between the Perkins Brailler and the PBR. Passages of appropriate graded difficulty were dictated to the student. The pre-conventional writing rate was 23.4 words per minute. Errors for this passage were .96 per minute. The pre-PBR writing rate was 13.6 words per minute with errors per minute being 1.28. The posttest was also conducted in the same manner. The conventional passage was written at 22.66 words per minute with .46 errors. The PBR passage was written at 17.06 words per minute with errors being at a rate of 4.16 per minute.

In summary, it appears as though she needs a lot more adapting to the writing features of the PBR. Both the writing rate and error rate were markedly decreased on the PBR as compared to the Perkins Brailler. However, there was an increase of almost four words per minute between the pre- and post writing rates on the PBR.

Child #4 - Ohio

Subject number four was a nineteen year old male in the eleventh grade in a public high school. He had spent six years in a class for the visually impaired.

He has no vision and braille is his only mode of reading. He began reading braille in kindergarten and grade two, fully contracted braille, by the classroom teacher in a special class.

Outside of the classroom, he reads books and magazines occasionally. He also listens to talking books.

Reading mechanics for this subject involve the use of both hands. He reads with the index finger of the right hand and uses the left hand to find the next line. He generally reads with the braille book flat.

He was a student with average academic ability but a superior memory for baseball statistics. He was always pleasant to work with.

Braille reading rates were collected for both conventional and PBR reading. Initially, his rates were calculated as 61.6, 58, and 75.6 words per minute on three separate passages of PBR reading were 47.5, 37.6 and 42 words per minute. After training and practice in the use of the PBR, his rates were again compared. On three passages of conventional braille, his rates were calculated as 64.5, 57 and 62.7 words per minute and his reading rates on the PBR were calculated as 34.2, 38.7 and 41.8 words per minute. Average reading rates were 65.06 for preconventional and 42.37 for pre-PBR. Post rates were 61.39 for conventional and 38.22 for PBR.

Error rate was also calculated for each passage. For the pre-conventional, there were 1, 3.1, and 2.1 errors per minute,

with an average of 2.9. Posttest errors per minute were as follows: 1.17, 1.83, and 1 for conventional, and 1, 1.33, and .83 for the PBR. An average error rate was 1.33 for conventional and 1.05 for the PBR.

The student was also asked to write passages of appropriate graded difficulty on the Perkins Brailler and the PBR from dictation. Writing rate and error rate were calculated for each passage. The results are: pre-conventional - 13.35 words per minute, .74 errors per minute; pre-PBR - 8.72 words per minute, .85 errors per minute. For the post-test they were: conventional - 0.82 words per minute, .48 errors per minute; PBR - 11.72 words per minute, 1.56 errors per minute.

In summary, this high school student seemed to be moderately satisfied with the PBR. He had a regular schedule of use and seemed to enjoy using the machine. Even though this student seemed to be quite happy with the PBR, his reading rates were slower on the PBR than conventional for both pre and post evaluations. Reading error rates were comparable for the PBR and conventional braille in both pre and post evaluations. The writing rate for the PBR was slower than the rate for conventional writing; however, there was improvement in the writing rate of the PBR. Error rates were less for conventional than PBR.

Child #5 - Ohio

Subject number five was a ninth grade girl at the state residential school for the blind. She is fifteen years old and has been in special classes for the visually impaired for ten years.

Her only mode of reading is braille. She began learning to read braille in kindergarten with instruction by the classroom teacher. Her instruction began with the braille alphabet, learning grade two, fully contracted braille.

Outside the classroom, she reads quite often and enjoys reading library books and magazines. She also enjoys listening to talking books.

Reading mechanics used by this girl involve reading with either hand and using the index finger of the right and left hand. She generally uses the left hand to find the next line. She reads with the braille book approximately parallel to the body.

Reading rates were collected on six passages, three for conventional braille and three for PBR reading. Average reading rates were calculated for conventional braille, initially as 69.33 words per minute and for PBR reading 37.90. After training with the PBR, rates were again calculated, conventional braille reading rates were 82.17 words per minute.

Error rate was also calculated for each passage. For the pre-conventional, there were 1.8, 2.8, and 2.5 errors per minute, with an average of 2.3. The pre-PBR errors per minute were 4.1, 3.1, and 2.6, with an average of 3.2. Posttest errors per minute were as follows: 2.5, 3.17, and 3.17 for conventional, and 3, 4, and 3.67

for the PBR. An average error rate was 2.95 for conventional and 2.56 for the PBR.

The student was also asked to write passages of appropriate graded difficulty on the Perkins Brailler and the PBR from dictation. Writing rate and error rate were calculated for each passage. The results were: conventional - 15.8 words per minute, 2.20 errors per minute; PBR - 14.6 words per minute, 2.33 errors per minute.

Results of the Evaluation and Research Program for the Portable Braille Recorder for this subject indicate a moderate unsatisfaction with reading on the machine because of the inappropriate syllabication. There was no indication from the pre to the posttest that she had adapted well enough to the slight differences of the PBR. Her PBR rates as compared to reading conventional braille were on both the pre and post a little over half as fast. This subject would prefer reading conventional braille which would seem to be more natural and something she is more used to.

Writing braille on the PBR was, however, a task she did enjoy. Her writing rate was compared to writing on a Perkin's Brailler was a little slower due to the newness of the machine on the pre test. However, an adapted change over time caused her to write equally well as on a Perkins Brailler for the posttest.

Error rate for both reading and writing was lower on the PBR than with conventional braille reading and braille writing equipment.

Child #6 - Ohio

Subject number six was a sixteen year old female who was in the ninth grade of the state residential school for the blind. She had attended special classes for the visually impaired for five years.

She has been classified as totally blind and has spent five years in a special class for the visually impaired. Braille has been her only mode of reading.

Instruction in braille began in the first grade with learning the braille alphabet. She began reading grade one, full spelling, braille. Braille instruction was provided by a resource teacher.

Outside of the classroom she reads braille books avidly. Listening to talking books is something she rarely does.

Generally, she reads with both hands using the index finger of the right hand and left hand. She uses the right hand to find the next line and reads with the book on her lap even though she is reading at a desk.

Reading rates were collected on six passages. Three for conventional braille and three for PBR reading. Average conventional braille reading rates were initially 90.6 words per minute, PBR rates were 41.23 words per minute. After some training, rates were again collected, average conventional rates were 81.22 words per minute, and average PBR rates were 46.16 words per minute.

Error rates were calculated for the reading passages in both conventional and PBR. This student's errors per minute on the pre-conventional passages were 3.1, 3.3, and 3.5 with the average being 3.3 per minute. Pre-PBR error rates were 3.5, 3.1, and 5.6

per minute. The average of those three is 4.06. After training and use of the PBR, reading passages were again given to draw comparisons. The posttest errors per minute on conventional braille were 4.83, 3.67, and 3.17. The average was 3.89. The posttest errors per minute on the PBR were 2, 1.83, and 3. The average was 2.27.

Comparisons were also made in writing braille between the Perkins Brailler and the PBR. Passages of appropriate graded difficulty were dictated to the student. The pre-conventional writing rate was 21.12 words per minute. Errors for this passage were 1.99 per minute. The pre-PBR writing rate was 20.33 words per minute with errors per minute being 2.11. The posttest was also conducted in the same manner. The conventional passage was written at 23.4 words per minute with 1.19 errors. The PBR passage was written at 21.4 words per minute with errors being at a rate of 1.14 per minute.

Results of the Evaluation and Research Program for the Portable Braille Recorder for this subject indicate a moderate satisfaction with the PBR as a device for the blind. Reading on the pre-test was half as fast as reading conventional braille. Errors were just slightly more on the PBR. The data indicates that an increase in reading rate occurred for the posttest. The most significant change, however, was in the error rate. This subject did twice as well when reading the post passages on the PBR as she did on the conventional braille passages.

Writing rate and error rate on the PBR were done equally well as writing on a Perkins Brailler. When the subject took a 50 word spelling test in her English class, she commented to me how nice and quiet the PBR was as compared to writing on a Perkins Brailler.

Child #7 - Ohio

Subject number seven was a nineteen year old male who was a senior in high school at the state residential school for the blind. He had attended a special class for the visually impaired for fourteen years.

He had no vision and braille was his only mode of reading. He began learning braille in the first grade. His classroom teacher provided instruction in grade 2 braille after learning the braille alphabet.

Outside the classroom he reads books and magazines occasionally, particularly enjoying sports and mysteries. He listens to talking books on occasion.

In reading braille, he generally reads with both hands using the index fingers of the left and right hands. He uses the left hand to find the next line. The book is usually positioned approximately parallel to the body.

Reading rates were collected using six passages of comparable grade level; three passages were read in conventional braille and three in PBR reading. Initially, his reading rates were 71.37 words per minute in conventional braille and 27.70 words per minute in PBR braille reading. After training in the use of the PBR, rates were once again collected. The reading rate in conventional braille was 67.87 words per minute and 42.95 words per minute for PBR reading.

Error rate for each passage was also calculated. For the pre-conventional passages, errors per minute were 3.83, 5.5, and 4.5 with an average being 4.61. For the pre-PBR passages, the errors

were 2.67, 5.67, and 4.5 per minute, averaging to 4.28. The posttest errors were as follows: conventional passage errors per minute were 2, 3, and 2 with an average of 2.3; PBR passage errors were .83, 1.6, and 2.3 per minute. The average was 1.57.

Braille writing was calculated by dictating passages of appropriate graded difficulty on both the Perkins Brailler and the PBR. The pre-conventional passage was written at 19.15 words per minute. Error rate was at 2.01 per minute. The pre-PBR writing rate was 17.01 words per minute with errors being 1.96 per minute. For the posttest, this student wrote 20.2 words per minute on the Perkins Brailler with 2.33 errors per minute. On the PBR, the rate was 15.6 words per minute with 3.02 errors per minute.

Results of the Evaluation and Research Program for the Portable Braille Recorder for this subject indicate a high satisfaction of reading and writing. This subject read very poorly on the PBR as compared to conventional reading. This was most probably due to a jumpiness he exhibited when pressing the touch control to call in a new line. A change in this subject over time and use of the machine definitely increased his reading rate on the PBR. An interesting fact that data revealed, too, was that error rate on the PBR for both pre and post was lower.

Writing rate and error rate on the PBR were done better than writing on a Perkins Brailler for both the pre and the posttests. His adaptation to the touch of the keys and transferring of the blocks was done immediately when he had not even been exposed to the machine.

Child #8 - Ohio

Subject number eight was a nineteen year old male in the twelfth grade who attended the state residential school for the blind. He has attended special classes for the visually impaired for fourteen years.

Braille has been his only mode of reading since he began reading braille in kindergarten. Braille instruction began with the braille alphabet and instruction in grade two, fully contracted braille. The classroom teacher in the residential school was his braille instructor.

Outside of the classroom, he reads braille books occasionally. Listening to talking books is an outside activity which takes quite a bite of his time.

Reading mechanics involved the use of both hands using the index finger of the left and right index finger. When reading, he uses the left hand to find the next line. The book is usually positioned approximately parallel to the body.

Reading rates were collected on six reading passages of comparable grade level, three for conventional braille and three for PBR reading. Initially, the average reading rate for conventional braille was 64.53 words per minute and 30.43 words per minute for PBR reading. After training with the PBR, rates were once again collected: average reading rate with conventional braille was 59.56 words per minute and 37.05 words per minute with PBR reading.

Errors were also calculated for each of the six passages. His errors per minute for the three pre-test conventional passages were 7, 8.17, and 9.33 with an average of 8.17. For the pre-PBR passages,

they were 7.33, 7.67, and 6.17 with an average of 7.06. When the post passages were read, he had 9.8, 5.5 and 6 errors per minute for conventional with 7.1 errors being average. On the PBR, errors per minute were 5, 4.8, and 4.16 averaging to about 4.65. An interesting fact that accounts for this student's high error rate was his inclination for making repetitions of words and phrases. This was especially true when reading conventional braille, but interestingly enough, on the PBR he did not make nearly as many repetition errors. This was probably due to the fact that after a line is read and changed to the next, it is not possible to repeat it.

Pre- and posttests were also undertaken for determining writing rate and error rate. Passages were selected of appropriate graded difficulty. Pre-conventional rate was 15.08 words per minute with errors being 2.42 per minute. Pre-PBR rate was 8.44 words per minute. No data are available for error rate. Different passages were written for the posttest. For conventional, this student wrote 17.5 words per minute, errors being 3.37 per minute. Writing rate for post PBR was 13.8 per minute, errors being 3.67 per minute.

Results of the Evaluation and Research Program for the Portable Braille Recorder for this subject indicate a high satisfaction. Braille reading for him was unique from the other subjects. Reading rate was just under half as fast for the PBR on the pre test. His rate increased over time with use as indicated on the posttest. The uniqueness, however, was in the error rate. Out of all the subjects, he had the highest, which I noticed was due to his inclination for making repetitions of words and phrases on conventional braille

reading. Interesting enough, though, on the PBR, he did not make nearly as much repetition errors probably due to the fact that once a line is read and changed, it cannot be repeated except from memory.

Writing rate for this subject was not as highly satisfactory as reading. His rate was slower on the PBR for both pre and posttests. Error rate, though, was approximately the same as writing on the Perkins Brailler.

Child #1 - Tennessee

This subject is an outspoken junior at the Tennessee School for the Blind. He resents not having been asked to participate in our project, yet has agreed to participate in order to help Michelle out with her job. (He was volunteered by the school principal.) He is very interested in electronics and stereo repair and feels qualified to criticize the PBR and to suggest improvements in design and features. He is embarrassed by his poor reading and spelling skills; he does not appear to read at grade level. He is much more confident and satisfied when reading junior high materials. He does not take his PBR to McGavock High School because he says he's "used to the way (he's) been doing things and (he) doesn't want to complicate matters." He often gets impatient with his PBR when he makes an error in operating it. Since February he has used his PBR when working with the school's ham radio equipment. He uses the PBR to take notes while translating Morse code. He requested that Michelle take his picture with the PBR and radio equipment to send to a ham radio user's journal. Despite his initial reluctance to participate in the project, at the end of the school year he requested to be included in any other research activities in the future.

Child #2 - Tennessee

This subject is a very friendly and talkative junior at Tennessee State School for the Blind. She is very much involved in school activities. She is mathematically inclined and plays the clarinet in the school band. She hopes to attend Vanderbilt University when she graduates next year. In her spare time, she is employed as a braillist at Tennessee School for the Blind under CETA sponsorship. She enjoys her PBR and uses it at McGavock High School to take notes. She required minimal instruction in operating the PBR and has had minor problems with it during the past months. She volunteered to read a computer-generated cassette book during the Christmas holidays.

She continued to be very cooperative with Michelle throughout the school year, in spite of her many extracurricular activities. In April, she participated in the Junior Olympics for Blind Athletes in Seattle, Washington and won several gold and silver medals in track and field events. She used her PBR increasingly at McGavock High School and at the Tennessee School. She requested the use of her PBR for her senior year at the Tennessee School for the Blind.

Child 3 - Tennessee

This subject is an independent and friendly senior at Tennessee School for the Blind. He has been active on the school wrestling team, and despite his heavy game schedule, has found time to meet with Michelle in the evenings. He has been very cooperative and seems to enjoy his PBR. Although he is partially sighted he prefers reading braille to large print. As the school year progressed, he did not use his PBR frequently. He participated in a work/study program in which he attended classes for only a couple of hours in the mornings, and therefore, did not see the need to use the PBR. Even though he did not use the PBR as frequently as other participants, he enjoyed it and cooperated in the data collection activities.

Child # 4 - Tennessee

This subject is a serious-minded sophomore at the Tennessee School for the Blind. He takes his participation in this project very seriously and prides himself in always being on time to appointments. He is very active in school affairs; he had a major role in the Tennessee School for the Blind Christmas play. He takes his PBR to McGavock High School and seems to enjoy using it. He reads braille very well and often helps explain things to the others.

He continued to participate all year in data collection activities. While Michelle had to make contracts with several of the students in order to collect the required amount of data, he did not want to be limited by the contract and would often participate in data collection activities on unscheduled days. He requested to be included in future research activities.

Child #5 - Tennessee

This subject is a very friendly and sensitive junior at Tennessee School for the Blind. He particularly enjoys the extra attention he receives from participating in this research; he often stops by to say hello on unscheduled days. He's also very helpful in conveying messages from Michelle to the others. He reads braille very well and seems to be popular with teachers and students alike. Until recently he worked at the student candy stand; he became concerned when students complained about his proficiency in the job. He uses his PBR at McGavock and always seems to be carrying it around with him. His participation in data collection activities decreased as the year progressed. Michelle had to contract with him to insure that the required amount of data was collected. However, he continued to enjoy reading with the PBR.

Child #6 - Tennessee

This subject is an outgoing and talkative junior at the Tennessee School for the Blind. She requested to participate in research activities and received her PBR in February. She had difficulties at the beginning of instruction with the touch switch, and consequently she had to modify her reading technique considerably. This, then, caused her to slow down her reading speed until she became accustomed to reading with one finger. She was very active in school activities and often forgot scheduled data collection meetings with Michelle. After agreeing to a contract for the project, her attendance and reading rates improved. Although she did use her PBR for taking notes, she frequently recorded lectures and listened to them later for study purposes.

Child # 7 - Tennessee

This subject is a seventh grade student at West End Junior High School, the only totally blind braille reading student in the Metro Schools. He was an excellent braille reader and was particularly verbal. He learned to use the PBR quickly and seemed to enjoy using it. However, his teacher often preferred that he not use the machine because she claimed it might get broken or stolen. Regardless of the number of explanations and assurances given to her, she persisted in limiting his class use of the PBR. During data collection activities, he was very attentive and cooperative. He enjoyed using his PBR and often made cassette tapes for Michelle.

Child #8 - Tennessee

This subject is a multiply-handicapped (blind and spina bifida) fifteen year old who attends an ungraded classroom at Harris-Hillman School. Although his braille reading skills were below age and grade level, he learned to read on the PBR without much trouble. Since note taking activities were unrealistic goals for him, pre-recorded braille tapes were loaned to him for reading at home. He lives with a foster family, an elderly couple who are not physically well themselves. He requires total care for all self-help activities and has very poor upper body muscular control. Although he could operate the PBR successfully at school with Michelle, it was soon learned that at home he could not lift the machine, nor communicate to his foster parents adequately to help him with it. Consultation with thephysical therapist revealed that he was not scheduled for therapy although he should have been in an exercise program to increase his upper body strength and control. Michelle began to have him practice lifting the PBR for increasingly longer periods of time; however, before any differences could be measured, he was hospitalized for surgery and did not return to school for the remainder of the academic year.

Child # 9 - Tennessee

This subject is a multiply-handicapped (blind and epileptic) thirteen year old in an ungraded classroom at the Harris-Hillman School. She was very enthusiastic and cooperative about participating in research activities. However, she had recently gone blind and was just learning how to read braille. As a consequence, her braille skills were quite poor. Nevertheless, she quickly learned how to operate the PBR, and she enjoyed practicing to read and write the braille words and letters she had learned. She had made considerable gains in her braille skills when she was hospitalized for surgery. She did not return to school for the remainder of the academic year.

Adult Users - Tennessee

Subject #1 received her M.S. in Special Education in August and used her PBR throughout the year for notetaking. She was the most satisfied and enthusiastic of all participants. She is presently saving money to buy her own PBR in the future. She worked part time on the project during Spring and Summer quarters, helping to train other college students and to prepare instruction manuals. She is presently employed as a special education teacher in South Carolina.

Subject #2 is a student in the M.S. program in Special Education. She was blinded late in life and is not confident of her braille skills. She relies entirely on audio recordings of lectures; however, she did use the PBR for a short period and thought it would be very useful for someone with good braille skills.

Subject #3 received his B.S. in Special Education in June. He has used the PBR for notetaking and for data collection activities on the project.

Subject #4 is presently a graduate student in the M.S. program in Special Education. He learned to use the PBR quickly, and he cooperated in the data collection activities.

Subject #5 is an undergraduate student in Special Education and has used her PBR all year long for taking notes in class. She has been very cooperative throughout the year.

Subject #6 is an undergraduate student in Special Education. She is very interested in technology and electronics. She has been very helpful in her suggestions to project staff about modifying the PBR and in data collection activities.

Subject #7 is a graduate student in the M.S. degree program in Special Education. She was blinded at the age of 18 and is not very confident of her braille skills. Consequently, she relies on audio recordings of lectures and did not find the PBR useful to her in class.

Subject #8 is a doctoral student in Special Education. She had considerable experience in the other technological developments for the blind, including the Optacon and Versabraille. She is presently using the PBR for notetaking and is also assisting project staff with the instruction manual.

CHECK LIST FOR EVALUATING BRAILLE EQUIPMENT

Indicate at the right which equipment you are evaluating. For each item below, indicate your judgement in terms of your present experience with the equipment.

Date _____

PBR _____

Perkins _____

WEIGHT AND SIZE:

Heavy 1 ___/___/___/___/___/___/___/ 7 Light

Comment: _____

Large 1 ___/___/___/___/___/___/___/ 7 Small

Comment: _____

Cumbersome 1 ___/___/___/___/___/___/___/ 7 Easy to Handle

Comment: _____

Not Easily Portable 1 ___/___/___/___/___/___/___/ 7 Portable

Comment: _____

Bulky 1 ___/___/___/___/___/___/___/ 7 Compact

Comment: _____

NOISE LEVEL:

Loud 1 ___/___/___/___/___/___/___/ 7 Quiet

Comment: _____

READING EASE:

Unsatisfactory 1 ___/___/___/___/___/___/___/ 7 Satisfactory

Comment: _____

Check List for Evaluating Braille Equipment

READING SPEED:

1 4 7

Slow ___/___/___/___/___/___/___/ Fast

Comment: _____

WRITING EASE:

1 4 7

Unsatisfactory ___/___/___/___/___/___/___/ Satisfactory

Comment: _____

WRITING TOUCH:

1 4 7

Unresponsive ___/___/___/___/___/___/___/ Responsive

Comment: _____

WRITING SPEED:

1 4 7

Slow ___/___/___/___/___/___/___/ Fast

Comment: _____

NECESSARY PREPARATION FOR USE:

1 4 7

Difficult ___/___/___/___/___/___/___/ Easy

Comment: _____

MATERIALS:

1 4 7

Bulky ___/___/___/___/___/___/___/ Compact

Comment: _____

1 4 7

Unavailable ___/___/___/___/___/___/___/ Available

Comment: _____

1 4 7

Inefficient ___/___/___/___/___/___/___/ Efficient

Comment: _____

MATERIAL OUTPUT:

Undesirable 1 4 7 Desirable

Comment: _____

OVERALL USABILITY:

Restrictive 1 4 7 Versatile

Comment: _____

Worthless 1 4 7 Valuable

Comment: _____

PBR RESEARCH PROGRAM RATING SCALE

The following questions ask you to compare the Perkins Brailler to the Portable Braille Recorder. Please answer each question by choosing the words which best fit your feeling or opinion.

Physical Aspects

Do you consider the Perkins Brailler.....

1. Ease of Handling. Easier - Harder - The Same

   Comments: _____

2. Weight. Lighter - Heavier - The Same

   Comments: _____

3. Size. Smaller - Larger - The Same

   Comments: _____

4. Noise. Quieter - Louder - The Same

   Comments: _____

5. Keyboard Height. Easier to reach - Harder to reach - The Same

   Comments: _____

6. Portability. More Portable - Less Portable - The Same

   Comments: _____

7. Compactness. In reading a book, would you prefer.....

   Braille volumes - The PBR - No Difference

   Comments: _____

Performance

Do you consider the Perkins Brailler.....

1. Brailling. Easier - Harder - The Same

   Comments: _____

2. Touch Perception (Dots). Easier to read - Harder to read - The Same

   Comments: _____

3. Braille display. Is the 12 cell display of the PBR.....

   Satisfactory - A Disadvantage - A Liability

   Comments: _____

4. Flexibility. Do you consider the auditory function of the PBR an asset that would lead you to prefer using it over the Perkins Brailler?

   Yes _____ No _____

5. In general, what features do you like best and what features do you like least about the PBR?

   Comments: _____

   _____

   _____

Appendix 5

Verbatim Transcripts of Student Comments

Features of the PBR Liked:

Subject		Best	Least
Adult Ohio	1.	Idea is good	twelve cell, one finger reading dots don't display well, for braille contractions, grammar and punctuation machine is detrimental
	2.		
	3.		keyboard, twelve cell display is fussy and unpredictable, recharging
	4.	read what you write on a cassette	complicated, too responsive to mistakes
	5.	ease of correction of braille errors, easier to braille	reading is a lot slower problems with equipment
	6.	storing braille to eliminate paper correcting feature and counter; quietness when brailling	battery life is too short can't operate off of wall current tone is too loud
Children Tennessee	1.		display too small squeals too much batteries, counter not satisfactory
	2.	Erase button	Squealing
	3.	audio recording eraser button (line) counter	touch control sensitivity, batteries inconvenient, battery indicator too small to read, turning on side
	4.	correction feature braille and recording braille notes in class; make a large mistake can blank it all out easier, easier to carry out	keys don't go down far enough; not enough spring in keys; having to use touch switch; takes too long to change block

Features of the PBR Liked:

Subject		Best	Least
Children			
Tennessee	5.	writing notes	dividing words
	6.	reading-playback what you've brailled when you write it doesn't make noise, on the whole I like it	the beep sometimes it doesn't work--like when it's hot and rainy
Adults			
Tennessee	1.	put books on cassettes, taking it to class and taking notes; don't have to braille backwards like counter	gravity switch; turning PBR off to rewind and ff; waiting between blocks when reading, it's o.k. in writing
	2.	writability--easily, rapidly, portability	twelve cell display; cost
	3.	noiseless, easy to operate	braille reading system, having to transfer to twelve-cell
	4.	small size, versatility--record in braille/audio Radio Shack computer, calculator, typewriter	beeps, audible tones are too loud; needs volume control; battery only good for a few hours words suddenly divided at end of line; cost is "somewhat" expensive; audio quality is poor (needs four-track recorder)
		comment: needs four-track playback tape, variable-speech control	
	5.	portability reduced size of books quietness ease of note-taking	lack of search capability like Versabraille; lack of twenty-cell display; imprecise pin height no means of knowing when battery is low; case - too little protection material produced on PBR does not transfer to another PBR-missing words

Features of the PBR Liked:

Subject		Best	Least
Adults			
Tennessee	6.	quietness (but have to get used to it) store braille on cassette use as an audio recorder and braille recorder	break in words (maybe not a problem after lots of practise) not so bad between syllables
		suggestions--raise touch switch or make switch a button	
	7.	noiseless in comparison to Perkins Brailler no paper needed no need for tape recorder dots cannot be depressed saves space	braille display too short divides words inappropriately easy for tape to mess up
	8.	portability silence	noise of keys keyboard is difficult in comparison to Perkins Brailler

Student Comments

"keys on PBR are too close together
the squeal detracts from the auditory function of the PBR"

"likes counter feature because you can go back and know where you're at."

"touch control is too sensitive--you can miss whole lines."

"batteries don't last long enough--always have to plug it in and in class sometimes you're shot."

"battery indicator is too small to read
Don't like to turn machine on side because if you're in a hurry you can forget to do it."

"Would use one in college if he could for note-taking--and prefers to read PBR cassettes if 'everything'. Nothing was wrong with them."

"The twelve cell display is a disadvantage because it chops words up in terms of reading."

"keys don't move well-they're too jerky" (don't spring back?)

"it's not easy to find notes on cassette"

"reading is difficult because of divided words. Writing is difficult because if you're not careful you can push eraser button. brailling with PBR is fine if you have time-it's much quicker to use the Perkins."

"sensitivity of the touch control--too easily changes the line--too many accidental touches."

"twelve-cell display--would prefer longer, more cells display."

"fix volume--recording is not good enough, (you've) got to lay your ear on it."

"take off the number buttons--you have to keep a file anyway."

"use my PBR for Morse code translation with my ham radio equipment."

"uses her PBR in her class to take notes--up till now she had only used it at McGavock."

"hates the words being cut up."

"the PBR is difficult to carry outside of carrying bag."

"instructions for using the Perkins Brailler are easier--PBR needs a manual."

"PBR's dots are more rounded."

"PBR's dotes are larger than regular dots and the braille cells are spaced further apart than regular braille, but you can get used to it."

ASSESSMENT AND EVALUATION OF THE PBR

One of the most exciting and important events in Braille technology has been unfolded with the emergency of the PBR. For a while back, mechanical devices designed for the writing of braille have proved irritating to many classroom teachers. Some blind individuals have had the unfortunate experience of being suspended from lecture rooms by the regular class teacher, simply because he (the teacher) could not tolerate the "hammering sound" from the Stainsby or the Perkins braille writer, and yet, these remained for several years the fastest and most efficient braille writers that could adequately meet the satisfaction of blind students receiving instruction in a "regular" setting. The slate and stylus equipment, on the other hand, is relatively noiseless, but more cumbersome to handle by most blind persons. Hence, its unpopularity even in present day training programs.

With the PBR, a new chapter has been opened in the communication systems for the blind. I found its greatest asset to be its noiselessness which will hopefully make it an ideal gadget for classroom use in respect to notetaking at a speed comparable to that of a sighted student utilizing ordinary pencil and paper. (My assumption here of course is that the user of the PBR must himself or herself be adept in the operational techniques of other braille writers with identical keyboards.) Coupled with the first advantage is the factor of "paperlessness". The PBR utilizes the conventional cassette tape, thereby eliminating time wasted in changing paper (as done on the Perkins and the Stainsby). Another time saving factor is the Erase key which works automatically when depressed.

Outside of the classroom, it is hoped that the PBR can serve a variety of purposes: In such professions as secretarial work, journalism, radio and TV discussion, and the like, which demand efficient note-taking strategies. The portability and noiselessness of the PBR are of tremendous advantage in such circumstances.

One other innovation in regard to the "writability" aspect is the unique advantage of computerized braille which the PBR offers. With minimum human effort, books can be transcribed into braille from a regulated computer with maximum accuracy and at a speed surpassing even that of a professional braillist.

I found reading on the PBR of such computer-produced books to be slow; about half of the speed in reading conventional braille. The setback in "readability" which the PBR suffers can be attributed to mechanical and tactile factors. One major mechanical limitation is in the 12-cell braille line (representing only about one third of the conventional braille line). The implication is that the reader too soon runs to the end of the line, making reading more demanding a task on the PBR. Again, the avid reader would discover that words broken at random at the end of a line and the frequent push of the switch button can diminish his reading appetite. Furthermore, in its present form, only the experienced braillist can fully enjoy reading on the PBR: beginners of braille and young children, unfamiliar with braille codes and structural clues as word length, shape, repetition, and spelling as ways of deriving meaning from a passage more quickly, should not be introduced to the PBR.

The glossy surface of "reading pins" makes sensitization of fingers considerably reduced. Although this is seen in the case of

thermoformed texts and in "solid dots" of magazines and texts produced by the RNIB, any improvement in this regard will be a welcome one for the PBR.

COST.

It is recognized that the PBR is at an experimental stage: hence its high cost of two thousand four-hundred U.S. dollars. In order to make this marvelous writing device within the reach of enthusiastic blind persons in various walks of life, its present cost must be considerably reduced.

CONCLUSION.

There is no doubt in my mind that the PBR has come to broaden educational and career horizons for the blind. With modifications to the 12-cell line (possibly 20 or more) and a reduction in the 10-second span presently required to switch from one reading block to another, reading speed will be considerably enhanced. In doing this, however, designers should bear in mind the advantage of retaining the present overall dimensions of the PBR. Other limitations worthy of note include: the gravity switch for reading and the two-track way in both brailling and taping that is currently available. In spite of these shortcomings, however, the modest beginning of the PBR certainly augurs well for the future.

COMMENTS ON PBR DIGICASSETTE

The following comment is primarily based on my personal experience and three weeks practice on the Digicassette machine. There are only two good things about the Digicassette machine --

1. Digicassette is a noiseless machine, it can be comfortably used in a meeting or in a classroom without fear of disturbing other members of the group.

2. It gives a better speed-writing than any Braille writer because all the ten keys are very light; you will only have to manipulate your fingers gently and as fast as you can, and it will give you a smooth braille.

CRITICISMS:

1. The display which consists of a line of 12 braille characters is very short. When reading back the text, the display line sometimes changes without the use of the touch-switch. In most cases the display line also divides the last word at the end of the line into two, that is it will give one-third or half of the word on a line, and then wait for the next line to read the rest of the word. All these problems are barriers to speed-reading.

2. It is important for the Digicassette machine to have a handle, because sometimes it can be very slippery.

COMMENTS ON THE PORTABLE BRAILLE RECORDER (PBR)

I had the PBR for about a month and within this period, I made the following observations.

1. The size and weight of this machine is very convenient for everyday use and for use several times in the day.

2. It is noiseless and so not distractable to other students in the classroom.

3. The fact that no paper is needed for writing on this machine makes it a time-saving device. Usually when blind students took lecture notes in braille using either the Perkins Brailler or the hand frame, a lot of time is wasted in changing and fixing new sheets of paper when one is filled.

4. Perhaps the most interesting aspect of this device is the fact that one can tape lectures and take lecture notes at the same time.

5. The use of this machine will require a lot of tutoring, but perhaps an instruction booklet in braille will help the blind in learning to manipulate the machine when a sighted person is not around.

6. One shortcoming of this machine is that at the end of the line, words are divided without regard to braille contractions or word syllabication. This sometimes makes it difficult to read words that have been continued on the next line. In braille, letters standing on their own can be interpreted as whole words. Perhaps making the line take up to 20 to 25 braille cells might help somehow.

7. For someone who is poor at reading braille, the PBR device might present difficulty in going through notes or reading other recorded materials. This group of people might benefit more from the PBR if this machine is designed in a way to record what has been brailled.

On the whole, the PBR is an excellent invention which a great percentage of blind students will benefit from.

Impressions of the Digicassette.

I did try to do some recording on it and was going to send you a sample of that when I put it on the this machine to continue recording with this one because I felt that it would be easier for a number of reasons. I heard Michelle's voice and my voice, and I knew several of you might want to listen to it and that would never do, so let me see if I am recording.

I found the Digicassette fascinating. That is a good word for it. I won't say that I had fun using it, I had an interesting experience. To me a fun experience is a play experience and I don't consider this a play toy, I consider this a very useful tool.

One of the main advantages to it is the amount of braille that can be stored. I was just thinking of the number of things, the types of things, that could be brailled. Music, for instance, and here you could use your alternating braille and sounds with perhaps the text in braille and then the arrangement on tape. The words in braille and then the words again on tape. Mathematics, which is very hard to understand on tape could be put into braille. A number of your science texts which are very hard to understand on tape. Foriegn language texts; sometimes people either do not have as good an ear or they prefer to use both tape and braille. Bibles, dictionaries, especially your large medical and legal ones. This list could go on and on, but also the machine is portable so that it can be carried around easily. You asked me what I was using it for. I will confess to you that I used it for this demonstration and project and experiment, whatever you wish to call it, alone for the simple reason that one disadvantage of this machine kept me from using it for other reasons except for reading the book, Psychics, and even then I had to be very careful.

The touch system is very, very sensitive and there is so much ease of operation,but then to play back, you have to tilt the machine on its side. This would be no problem for most persons with visual impairment; however when you put other impairments with

visual ones, arthritis of the spine with the cerebral palsy, which creates at times unsteadiness of the hands, I was afraid that I was going to drop the machine when I tilted it a couple of times; so I think the method of retrieval could certianly be changed. I think there does need to be some improvement. Now, this is not going to hinder your average, normal blind person. Also persons with diabetic neurophy would have a problem. Any person with a motor sensory or orthopedic or handicap or disability other than deafness is going to have a little problem, I am afraid. Now, most of the buttons are big enough to handle. The cassette eject and the pause I would say are a little bit small. I could handle them, but I could see problems for some people. The problems in retrieval are almost overshadowed by the ease in writing with this particular machine. I have been advised as have a couple of other people that I have heard of, not to write braille too often with the braille writer - it puts a lot of pressure on the spine and I am unable to use the stylus and slate. There is no pressure with this machine and as long as you do not write too fast so that you do not skip lines, writing is a breeze. That may sound like it is making light of it, but it really is, writing is very easy to handle. Reading is not all that difficult once you've got it on playback. I will say that the system is very, very sensitive and people with coordination problems who read braille, might have a problem with the finger dexterity in getting the finger off quick enough before two lines have come down. But, I think the person would eventually get use to this. Also, Michelle, as you mentioned, the fact that the batteries are so hard to get at is a disadvantage because I am sure that most people would want a machine that is easily handled in that respect also. I think the fact of its portability overrides this other problem and I am sure that in future machines by whatever country they are made, I am sure technology can improve on this. Also, the sound system for telling you when you are at the end of a block is very good both in reading and writing. And this is an advantage. I was surprised, therefore, if they could develop such a sophiscated touch and sound system, and I not talking about recording, I am talking about the sort

of buzzer when reading and the beeps for reading and writing. Why they could not make this with an automatic shut-off and with an automatic volume level. I think that this would be a disadvantage either in alternating braille and sound or if braille and sound were put together. And I will just say this right here, I would be more of a simultaneoue person that I would be a alternating person. In other words, I would tend to write and talk at the same time. Not all professors are sighted, of course, and I am sure that some of them in lecutring would be brailling at the same time if they wanted to keep a copy of their lecture. This was one of the few examples I could think of. If I were explaining something to someone, or if anyone were, and they wanted it in braille, if the braille and sound were put together, then it could be done simultaneously. I do not think that it is necessarily a disadvantage that this one does not have it, but I think that the combination is definately possible in technology. I enjoyed reading, "Physics". I had a little trouble with that book because I never found the end of side one and I never did find anything on side two. If in playing I did something wrong to the tape, then it is my apology. If indeed there was a mistake made before I received the tape, then that, of course, is none of my doing. Let me say this, I enjoyed the method of reading and therefore I enjoyed the reading I did. I do not believe a word of what Jean Dixon and these other physics were saying, but as Voltaire would say, "I defend the death their right to say it."

The fact that we have such a thing in technology is phenonmenal, and as I mentioned, I think the fact that we can store the amount of braille that we will eventually be able to store is phenonmenal. The fact that we can hook this machine up to a computer is amazing. I don't know what external microphone this machine takes. I was trying to get one, but mine did not fit it. The quality of the recording it not that good, but I think that will eventually improve with experience by makers, etc. I would like to see a machine, as I mentioned, that would shut-off

and have the automatic volume level because if you had all of your equipment in one machine, I think that this would put a person in extremely good shape. Sometimes you might just have a little bit that you wanted to be in braille and the rest on tape, but you could have it all there with you in a very portable fashion. So, I really had some enjoyable times. I think the writing, aside from reading, the writing was the thing that I most enjoyed because of the physical ease. It really was easy. I have to say that that machine is not compatible with a lot of other machines, and this could prove to be a disadvantage at some point. I am wondering if we could, I know that the government would not approve, the Library of Congress would not approve of using a French product, but I am wondering if we could pattern something akin to it. Take the good things that I have mentioned and add to them some of the other things that I have mentioned. I think that eventually paperless braille could become a medium for a lot of people. Older people who really want to learn braille but who don't want bulk. Some people don't have that much trouble in the touch, but because of the bulk, they leave it alone. This was one of my findings. Most braille books are so large that people with other disabilities cannot lift them. With this paperless braille machine, it is not that hard to lift, and if you took away the tilting aspect and did something about this retrieval system, I can see numerous possibilities. The counters are another thing that I was really glad to see. It is the first machine that I have seen with a braille counter. And, I did not use it that much, but I can see where it would be of great help, especially brailling indeces, finding the alphabet parts; for instance, if "b" started on a separate block from "a", then this would be helpful in looking up words in a dictionary, for example. This is where in foreign language use your alternating tape and sound could come in except that I would like to see it either simultaneous or one right after the other. The spelling of the word orally then the seeing of it in braille. So, its been a very interesting experience. I want to

thank you for the opportunity of using this machine.

I would like now to make some comments on the manual. I first would like to make an apology. I am afraid that I don't handle thermoform well as your thermoform copy is not in the condition that it was in when I gave it to you. Thermoform paper and I have never gotten along, infortunately, although I try to handle it, but its a very good manual and I think that it goes very far in its explanations. A couple of the things that you mentioned to me might have been put in the manual. For instance, if you had stated in the manual where everything was, for instance, the adapter, how to open the Digicassette box. In other words, start out with getting the machine out of the box. By the way let me insert here, that I would like to apologize to you that we had to call and ask about the adapter. I had a little bit of a problem, again, of balance; and I do not think it would be a problem to the average person. I could not get the machine out of the box without aid because of a balance problem. I would have had to sit down on the floor to handle it, so it was a matter of the box being too large rather than too heavy. At any rate, if it could have been mentioned in the manual where the adapter was. Another thing I would have liked to have seen in the manual, although I have found out through experimentation, whether you can erase a braille tape, whether you can erase a sound tape with this machine. Whether you can put sound where braille was or braille where sound was. In reusing tapes, you are only going to be able to keep so many tapes, and after books got old, I was wondering what was going to happen where if copies were worn out, you would have to make new ones. So, this question did come up. But, I think that manual is very good. I don't see where is could have been simplified. It seemed that is was oversimplified in a couple of places and yet I can see why and I don't think it should be changed. Its a matter of who is handling it. There is one other thing that I would have liked

to have seen -- I had extreme difficulty handling the Thermoform paper, and then going back to the machine. If I had been able to take a taped copy of that manual and listen to it on another recorder, and then just reach over to the machine, this would apply not only to arthritics, but to persons with diabetic neurophy and other people who have trouble at times actually reading braille. I think that all of the disadvantages that I mentioned can be overcome, if not in this machine, then in future ones. How about my saying, "that technology enables us to make those improvements. If the system developed for this machine is not beyond our scope, then adding the few other things and changing a couple of things, is not beyond our scope." I would like to reserve the remainder of this side for braille I would like to see if Cheryl can read my braille and again I have enjoyed using the machine. It was a real challenge and personally, even though the main disadvantage of the retrieval system was quite a challenge, it was interesting to overcome. I say the main one, of course the main disadvantage is the cost and any time you improve technology, you are going to have an increase in cost. I think those of us who would like to read braille sometimes, I am not that much of a braille reader, I do most of my reading on tape. I don't write much braille. Most of it is just my own bookkeeping. I think a machine like this would be just excellent with those changes made, I would like to see it.. . . . . .
I think its alright to say that the quality could be improved on the audio if that person were furnished the machine and could not afford their own and if this were their main machine then it might be feasible to combine a flexible disc-cassette combination like they're talking about now with the paperless braille system some day and have all of your equipment right there together. Who knows, but if that is not a person's main source of recording, then I think the quality is good enough for ordinary purposes. The reason that I would rather use my own machine is that

my ear is different from most other people's because of the foreign language and music training.

A couple of things that I neglected to mention. It would have been helpful if the manual had stated whether the tape could be used on one side or both sides in braille. Your tape, Michelle, gave me that information. Of course, I would have experimented and found out. Some people wouln't have. Also, if you had made it plain whether or not the tape would erase both in braille and on tape, I think it would have been helpful to people, but otherwise, truly, I think its a fine manual for such a complicated piece of equipment. Now I will reserve the remainder of this tape for my philosophy of life. It will be written in braille and it consists of three quotes from authors whom I respect very highly. With that, I would like to thank you again very much for the opportunity to evaluate this machine. If you have any further questions, I hope that you will not hesitate to phone me at the number which you have if you can reach me. I know I am hard to reach, or send me a tape, I will be glad to answer it. Thank you.

Log of Equipment Malfunctions

10126	1/18/78	Braille function not working-only audio
	2/13/78	Contact under key cap stuck
	8/17/78	Pins not working. Sent to ELINFA, returned 10/78
	12/5/78	Machine would not play back braille and would not transfer braille to memory. Examination revealed that child did not type four additional cells after the beep at 116. When she was reinstructed to do that, the machine worked.
	5/5/79	Inconsistent braille playback-changed batteries
10128	3/29/78	Replaced batteries
	5/30/78	Braille function not working-only audio. Pins not working
	7/28/78	Machine not working at all. Sent to ELINFA, returned 10/78
	12/5/78	Machine wouldn't open cassette door. Problem was that cassette recorder had slipped under PBR metal case-fixed it right there.
	12/7/78	Machine hums when playback audio tape.
	12/12/78	Tape did not play back-examination of tape revealed twisted, faulty tape-threw out the cassette.
10129	4/20/78	Battery pack replaced
	6/11/78	Pins are inconsistent height, audio hum. Sent to ELINFA, returned 10/78.
	4/79	Continuous high pitched sound-Sent to ELINFA. Returned 7/9/79
10132	6/12/78	Machine hums in audio mode
	12/78	battery charger not working. Had to adjust the voltage regulator button on battery charger.
10133	6/12/78	Pins inconsistent
	8/17/78	Tape stuck in recording/playback mechanism
	4/79	Acts like it's in audio when in braille mode. Sent to ELINFA. Returned 7/9/79
10136	1/18/78	Batteries needed charging
	6/11/78	Batteries needed charging
	6/12/78	Inconsistent pins
	7/3/78	Pins not working, burning smell. Sent to ELINFA, returned 10/78.
	2/79	Machine had problems with the touch switch--it would not change the display. After machine had been in office for 30 minutes it returned to normal. Problem may be due to cold weather.
	4/79	Machine inoperable-20 cells broken and high pitched sound. Sent to ELINFA. Returned 7/9/79

Log of Equipment Malfunctions

10137	1/18/78	Charged overnight-no braille reading. Hissing microphone.
	6/11/78	Display changes independently.
	8/17/78	Braille mode does not function.
	12/78	Tape eject button got stuck; forced it open. Battery charger seems to have a short in it.
	2/79	Machine inoperable-the machine acts like it's in the audio condition whenever it is in the play or record mode. Will not accept or play back braille. Machine returned to ELINFA in Washington, D.C.
	3/79	Machine returned from ELINFA but cassette eject button was not fixed.
	5/79	Continuous high pitched sound-machine needed to be plugged in batteries recharged.
10138	4/20/78	Braille mode not functioning.
	8/17/78	Pins not displaying correctly.
	5/5/79	Inconsistent playback-changed batteries.
	8/79	Sent to ELINFA due to constant high frequency noise. Returned 9/79.
10140	1/18/78	Charged overnight-still not working-changed batteries.
	4/24/78	Inconsistent record-hums. Problem with inconsistent pins.
	6/12/78	Batteries need recharging.
	2/79	Machine was returned to ELINFA because of a persistent loud noise whenever in play or record modes. Six braille dots were broken and one spring in the counter button was missing. Returned 3/79.
	8/79	Machine sent to ELINFA due to constant high frequency noise. Returned 9/79.
10142	3/24/79	Sent to Washington because of high pitched tone. Arrived back 4/21/79.
	8/79	Machine sent to ELINFA due to acting like audio recorder in braille mode. Returned 9/79.
10144	8/17/78	Pins not coming up correctly. Sent to ELINFA. Returned 10/78.
	5/79	Machine is inconsistent in playing back braille-sometimes it will play the first brailled block on a tape; at other times it won't.
	5/79	Machine skipped lines without touching the touch switch. May have been due to hot day and/or moisture on Linda's fingers.
10145	5/25/78	Touch control does not move consistently.
	5/30/78	Pins do not move correctly. Machine sent to ELINFA. Returned 10/78.

Peabody Media Center repaired one broken external battery supply.

Appendix 7

Sample Reading Materials - Children

Children's Reading Passages

PBR

James and the Giant Peach

Charlotte's Web

Little House in the Big Woods

Robbie

How the Typewriter Changed Women's Lives

Little Women

Close Encounters

The Greatest American Athlete

The Great Train Robbery

Conventional Braille

Sounder

Benny the Misfit

Secrets of Indian Feathers

The Clue of the Dancing Puppets

Living Free

A Look of Eagles

Herbie Rides Again

Welcome Back, Kotter

Island at the Top of the World

Project #710758
3/13/78

Little House in the Big Woods

The house was a comfortable house. Upstairs there was a large attic, pleasant to play in when the rain drummed on the roof. Downstairs was the small bedroom, and the big room. The bedroom had a window that closed with a wooden shutter. The big room had two windows with glass in the panes, and it had two doors, a front door and a back door.

All around the house was a crooked rail fence, to keep the bears and the deer away.

In the yard in front of the house were two beautiful big oak trees. Every morning as soon as she was awake Laura ran to look out of the window, and one morning she saw in each of the big trees a dead deer hanging from a branch.

Pa had shot the deer the day before and Laura had been asleep when he brought them home at night and hung them high in the trees so the wolved could not get the meat.

That day Pa and Ma and Laura and Mary had fresh venison for dinner. It was so good that Laura wished they could eat it all. But most of the meat must be salted and smoked and packed away to be eaten in the winter.

For winter was coming. The days were shorter, and frost crawled up the window panes at night. Soon the snow would come. Then the log house would be almost buried in snowdrifts, and the lake and the streams would freeze. In the bitter cold weather Pa could not be sure of finding any wild game to shoot for meat.

The bears would be hidden away in their dens where they slept soundly all winter long. The squirrels would be curled in their nests in hollow trees, with their furry tails wrapped snugly around their noses. The deer and the rabbits would be shy and swift. Even if Pa could get a deer, it would be poor and thin, not fat and plump as deer are in the fall.

The night seemed long. Wilbur's stomach was empty and his mind was full. And when your stomach is empty and your mind is full, it's always hard to sleep.

A dozen times during the night Wilbur woke and stared into the blackness, listening to the sounds and trying to figure out what time it was. A barn is never perfectly quiet. Even at midnight there is usually something stirring.

The first time he woke, he heard Templeton gnawing a hole in the grain bin. Templeton's teeth scraped loudly against the wood and made quite a racket. "That crazy rat!" thought Wilbur. "Why does he have to stay up all night, grinding his clashers and destroying people's property? Why can't he go to sleep, like any decent animal?"

The second time Wilbur woke, he heard the goose turning on her nest and chuckling to herself.

"What time is it?" whispered Wilbur to the goose.

"Probably about half-past eleven," said the goose. "Why aren't you asleep, Wilbur?"

"Too many things on my mind," said Wilbur.

"Well," said the goose, "That's not my trouble. I have nothing at all on my mind, but I've too many things under my behind. Have you ever tried to sleep while sitting on eight eggs?"

"No," replied Wilbur. "I suppose it is uncomfortable. How long does it take a goose egg to hatch?"

"Approximately thirty days, all told," answered the goose. "But I cheat a little. On warm afternoons, I just pull a little straw over the eggs and go out for a walk."

Wilbur yawned and went back to sleep. In his dreams he heard again the voice saying, "I'll be a friend to you. Go to sleep--you'll see me in the morning."

He got a good price for The Cat from a racing enthusiast from Detroit with more money than horse sense. The two-year-old gray soon changed hands again, though not before another firing, and not before he had become totally unmanageable on the track and had badly crippled an exercise boy. In midwinter, the next time The Cat was sold, the price was considerably lower.

He was purchased as a jumper prospect, and his new owner was a good horseman who often took horses "straight off the track" and turned them into valuable riding horses. For months he worked with The Cat, gaining his confidence, building up his legs and muscles, and finally training him to jump a little.

The Cat took to jumping with enthusiasm. His trainer was experienced enough not to rush the colt, who was still only two years old. By the time he'd turned three and they were beginning to use the outdoor ring, The Cat was still working only lightly, jumping low obstacles with ease and perfecting his balance, coordination and timing. Most important, he was once again learning to trust a man. Then, with other young horses to start, his owner, deciding that The Cat was ready to sell as a riding horse, took him to an auction. There Jack Barrows, attracted by The Cat's size--almost seventeen hands now--and his heavy muscling, bought him.

Jack Barrows had made his reputation one of strength and courage in power jumping classes, where the obstacles were high and demanded speed. Barrows was also known for getting trophies with a horse, fast, no matter how rough they were. He was not noted for his patience.

He was aware that The Cat had once had a reputation as a "behavior problem". But he knew how to deal with behavior problems. He prepared for his first workout with the stallion by having him bitted in a long-shanked curb with a tight chain, and he picked out his heaviest riding crop. The first thing Barrows did was try to provoke a fight with The Cat, feeling that the sooner the horse realized who was giving orders, the better. He jerked on the harsh bit, spurred the horse's sides, and gave him a few smart raps with the crop.

After the kind treatment he had been receiving lately, The Cat reacted to this sudden abuse by standing motionless, except for the faint quivering of his muscles. In his eyes the look of eagles burned brightly. Barrows noticed nothing and was very pleased with himself. He manhandled The Cat through a fifteen minute warmup, then put him on a track that led around to a high jump. The Cat broke into a gallop, arching his neck to ease the action of the curb. Barrows saw that the horse was going to rush the jump, but he had no doubt that he could clear it. Instead of trying to pull his stallion down to a reasonable speed, he gave him the whip. Two stable boys standing by the rail watched open-mouthed as The Cat hit the takeoff point at a full gallop and Barrows yelled in his ear. The gray horse soared, clearing the jump easily even though it was much higher than he was used to. But he landed badly with a hard jolt. Barrows hauled him around and started him on another turn of the ring at a good gallop.

Barrows was elated. Visions of huge trophies flashed through his mind. This was a "power jumper" if he'd ever seen one! Now to put him over it a few more times--fast, before he lost his steam--get him used to charging, then raise the jump higher.

The Cat approached the jump at a terrific speed; again he flew over it with plenty to spare. But the two boys at the rail could see what Barrows could not--the stallion's eyes were getting wild and white-ringed. Every time Barrows yelled, or jerked the bit, or jabbed with his spurs, the horse's eyes grew wilder. By the fourth approach, still at a gallop, the gray's eyes were nearly crazed with fright and anger.

This time he charged at the jump so hard that even Barrows began to have second thoughts. The horse smashed straight through the two rails. They were flung aside and struck the ring fence several yards away.

His knees had been badly knocked, but The Cat continued to charge around the ring, swinging his head from side to side, completely out of control.

Barrows was scared. He'd never before been on a horse he couldn't control. Finally The Cat slowed down enough from his frenzied racing for Barrows to slide off and drag him to a halt. The horse stood panting, the sweat running down his legs.

Embarrassed by his scare and his humiliating departure from the horse's back, Barrows decided that now, while The Cat was tired and winded, was a good time to settle this thing- and save his own face a little. He called sharply to the two boys.

"Fasten those rails down! I want 'em good and solid this time. If he hits it again he'll know he hit something!"

The boys hesitated, but a snarl from Barrows sent them through the fence, where they locked the two heavy rails in place. With wide wings on the standards, the jump was now virtually immovable.

Barrows remounted. With crop and spurs he put the tiring horse into a canter. Circling the ring on weary legs, The Cat approached the obstacle once more. He was an immensely strong horse; he still had plenty of power left to clear this jump, and he began to charge.

But this time he took off several feet too close and dived straight at the top rail, which held for an instant and then snapped loudly, splintering. Horse and rider went down amid the wreckage of the jump.

When the dust began to clear, The Cat was sitting up on his haunches, and Barrows's leg was caught beneath him. The Cat shifted his foreleg, got his hocks under him, and lurched to his feet. The boys climbing through the fence watched in horror as one steel-shod hoof kicked out savagely and caught Jack Barrows on the side of the head, killing him instantly. The boys froze. They'd seen jumping accidents before. What shocked them was the fact that this was no accident. The gray horse was a killer.

The Great Train Robbery

Wholly unprepared and entirely miscalculating the effects of the physical principles involved, Edward Pierce slung a coil of rope over his shoulder, opened the train compartment door, and clambered up onto the roof of the moving carriage. His only true protection--and the source of his audacity--lay in his complete misunderstanding of the danger he faced.

The wind struck him like an enormous fist, screaming about his ears, stinging his eyes, filling his mouth and tugging at his cheeks, burning his skin. He had not removed his long frock coat, and the garment now flapped about him, whipping his legs "so fiercely that it was painful."

For a few moments, he was totally disoriented by the unexpected fury of the shrieking air that passed him; he crouched, clutching the wooden surface of the coach, and paused to get his bearings. He found he could hardly look forward at all, because of the streaking particles of soot blown back from the engine. Indeed, he was rapidly covered with fine black film on his hands and face and clothing. Beneath him, the coach rocked and jolted in an alarming and unpredictable fashion.

He very nearly abandoned his intent in those first moments, but after the initial shock had passed he determined to go forward with his plan. Crawling on his hands and knees, he moved backward to the end of the coach, and paused at the space over the coupling that separated his carriage from the next. This was a gap of some five feet. Some moments passed before he gathered the nerve to jump to the next car, but he did so successfully.

From there he crawled painfully down the length of the car. His frock coat was blown forward, covering his face and shoulders and flapping around his eyes. After some moments of struggle with the garment, he shucked it off and saw it sail away, spun twisting in the air, and eventually fall by the roadside. The whirling coat looked enough like a human form to give him pause; it seemed a kind of warning of the fate that awaited him if he made the slightest error.

Freed of the coat, he was able to make more rapid progress down the second-class coaches; he jumped from one to the next with increasing assurance, and eventually reached the luggage van after a period of time he could not estimate. It seemed an eternity, but he later concluded it had not required more than five or ten minutes.

Once atop the van, he gripped an open slapper, and uncoiled his length of hemp. One end was dropped down the slapper, and after a moment he felt a tug as Agar, inside the van, picked it up.

Pierce turned and moved to the second slapper. He waited there, his body curled tight against the constant, unyielding blast of the wind, and then a ghastly green hand--Agar's--reached out, holding the end of the rope. Pierce took it; Agar's hand disappeared from view.

Pierce now had his rope slung from one slapper to the next. He tied the loose ends about his belt, and then, hanging on the ropes, eased himself over the side of the van until he was level with the padlock.

In that manner he hung suspended for several minutes while he twirled the padlock with a ring of picks, trying one betty after another and operating, as he later testified

with considerable understatement, "with that degree of delicacy which circumstances permitted." Altogether, he tried more than a dozen keys, and he was beginning to despair that any would turn the trick when he heard the scream of the whistle.

Looking forward, he saw the Cuckseys tunnel, and an instant later he was plunged into blackness and churning sound. The tunnel was half a mile long; there was nothing to do but wait. When the train burst into sunlight again, he continued working with the keys, and was gratified when almost immediately one of the picks clicked smoothly in the mechanism. The padlock snapped open.

Now it was a simple matter to remove the lock, swing the crossbar free, and kick the door with his feet until Burgess slid it open. The morning train passed the sleepy town of Godstone, but no one noticed the man dangling on the rope, who now eased down into the interior of the luggage van and collapsed on the floor in absolute exhaustion.

742

Appendix 8

Sample Reading Materials - Adult

Adult Reading Passages

PBR

The Killer Whale by Tom Cheeseman

Pandora's Box by Edna Preston

The American Turtle by John E. Jennings, Jr.

The Brave Deed of Elizabeth Zane by Helen Frackenpohl

You - And the Amazing Thinking Machine by Phillis Wilner

A Fortune in Blue Jeans by Stanford Taylor

Conventional Braille

Over the Hills and Far Away by Dunsany

Island of the Blue Dolphin by O'Dell

Prize Stories 1976, the O. Henry Awards, Abrahams (Ed.)

The Greatest American Athlete

by Michael J. Fitzgerald

Preview:

1. Read the title.
2. Look at the picture.
3. Read the first two paragraphs.

Then answer the question on the bottom of the next page.

Who is the greatest American athlete? Would you say it was Stan Musial, who played major league baseball for more than twenty years? Or Babe Ruth, the home run king? Maybe you like Jimmy Brown, the great back of the Cleveland Browns, or Willie Mays, who seems to climb walls to catch baseballs.

The question could start hours of good talking. Many people who have been sports fans for a long time are sure the greatest American athlete was Wa-Tho-Huc. That's an Indian name which means "Bright Path." But sports fans knew him as Jim Thorpe.

Jim Thorpe was an Indian who was born in Oklahoma in 1888. One day when Jim was seven, his father, Big Hiram, took the boy to school. It was a three-mile walk to school from the Thorpe home. His father

left Jim at school and walked back home. Big Hiram had been home only a few minutes when Jim came in the house. "I don't want to go," Jim said.

His father took the boy's hand. "You come, boy!" Together they walked the three miles back to school. This time Jim waited at the school door until his father was out of sight. Then he started to run, using a short cut he knew. He was home well before Big Hiram.

The father looked at Jim. "We each went twelve miles today, Jim. But I'm tired out. No more school today!"

That night, Jim's father decided to send Jim to an Indian school. It was hundreds of miles away in Kansas. "He won't be able to run back from there!" Hiram said.

Jim went to school in Kansas until he was seventeen. Then he went to Carlisle Indian School in Pennsylvania. There, Indian boys could learn a trade. The school also had teams in many sports.

One day during football practice, the coach saw Jim standing on the sidelines watching.

"Know anything about the game, boy?"

"No, but it looks easy," said Jim.

"Easy, huh? Well, take the ball and see if you can run through those eleven men."

Players came at Jim from all directions. He twisted and turned, ran backwards and sideways. Soon eleven football players were on the ground and Jim was standing all alone on the goal line. "No one puts down Jim," he said, grinning. Pop Warner knew he had a born football player.

How good a football player was Indian Jim? Well, Carlisle played some of the top college teams in the country, but they never could stop Jim. He was six feet tall and tough as steel. One season he made 25 touchdowns in eight games. In one game he kicked six field goals. One was for 50 yards. In another game, Jim ran 95 yards for a score.

In one game the other team began to play dirty, punching Jim during a pile-up and jabbing thumbs in his eyes. Other players on Jim's team were mad, but not Jim. He walked over to the other team. "You guys can't stop me," he said quietly. "On the next play I'm going around right end." And he did, making seven yards. Then he said, "Now I'm going through center." And he smashed through for twelve yards. And for the rest of the game, he told them where he was going to run on every play. Carlisle won by three touchdowns.

Jim was not only a great football player. He did well at every sport he tried. He was almost a one-man track team. In one meet, he won the pole vault, high jump, 200-yard low hurdles, the shotput, and the broad jump. He didn't think he did so well, though, because he came in second in the 100-yard dash.

Jim Thorpe was chosen to go to the 1912 Olympics. He entered two of the hardest events, the Pentathlon and the Decathlon. The Pentathlon is made up of five kinds of track events, the Decathlon of ten. While other athletes were practicing for days to get ready, Jim slept or took long walks.

What happened at the Olympics? Jim won both of these events. This had never been done before, and has not been done since.

In case you still don't think Jim Thorpe was the best athlete the United States has ever had, listen to this. Jim Thorpe played major league baseball and football. He was also a star in basketball and could play tennis with the best in the sport. And when it came to lacrosse, a rough Indian game that is played in many parts of the country, no one was better than Big Hiram's son. He was a crack shot with a gun, too.

That was Wa-Tho-Huc. Many say he was Babe Ruth, Stan Musial, Willie Mays, Jimmy Brown, and a hundred other athletes all rolled into one!

What do you think?

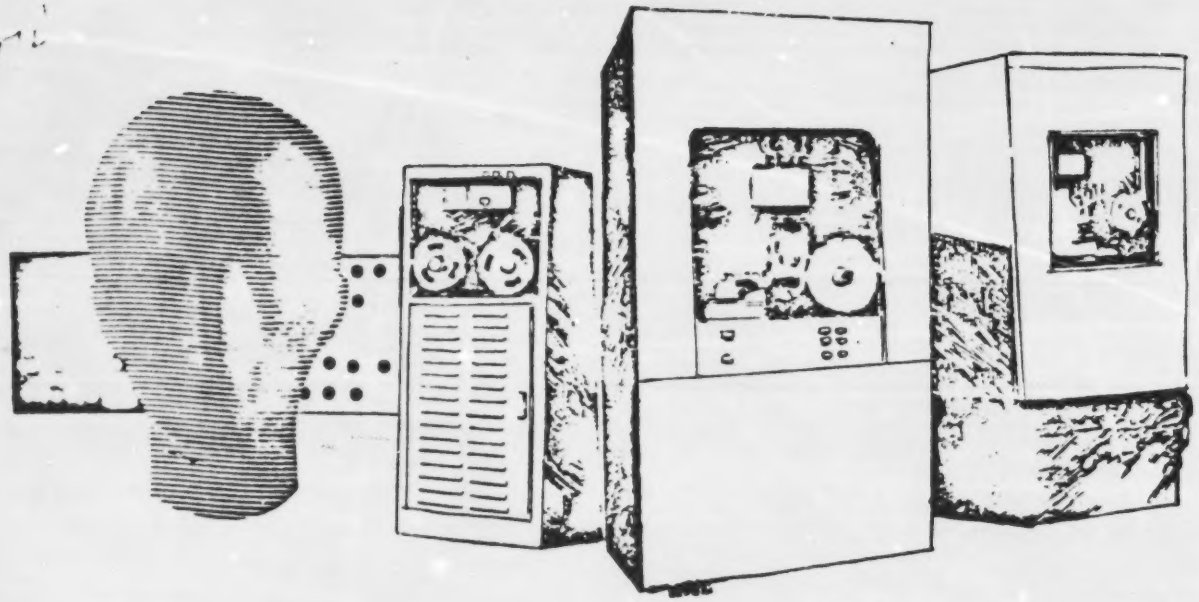
From your preview, you learned that this story is about

.....a. Stan Musial.
.....b. Jim Thorpe.
.....c. the Wa-Tho-Huc Indians.
.....d. the Cleveland Browns.

The answer to this question can be found on page 109.

You—and the Amazing Thinking Machine

by Phyllis Wilner.



After you have looked at the title, author's name, and illustration, preview the selection this way:

1. **Read the first paragraph.**
2. **Read the first sentence of each of the other paragraphs.**
3. **Read the last paragraph.**

Then answer the question on the bottom of the next page.

If you were one of the millions who watched and listened as America's astronauts landed on the moon, you saw history made before your eyes. If you counted the number of times the astronauts and their flight controllers used the word "computer," you realized that computers made that thrilling moment possible.

Without computers, there probably would have been no moon landing and not much of a space program either. In fact, computers are making such tremendous changes in our way of life that many people feel they are causing another great industrial revolution.

Today, it would be difficult to conduct the day-to-day business of the United States government without computers. There might not be an accurate government census every ten years, or a regular check on millions of income tax returns, or any of a thousand different government operations.

Without computers, hundreds of industries would find it difficult to operate, to expand, to improve existing products, and to develop new ones. Computers are used to issue paychecks, to bake cakes, to control traffic, to set type for books, to catch criminals, to teach students, to plan space flights, and to perform thousands of other useful tasks. The sounds of busy computers can be heard in banks, in airports, in hospitals, in publishing companies, in factories, in business offices, in libraries, in schools, and far out in space.

But, what exactly IS a computer? A computer is a device which counts or figures. It can add and subtract; it can compare and select; it can sort and process. Most important, it can perform these tasks at speeds that are far beyond man's ability even to imagine them. Some modern computers can make one billion calculations in one second.

But even the most advanced computer can do all these things only if it has been given sufficient information and proper instructions. As the computer programmers say, "Gi-Go," or "Garbage in, Garbage out." A computer is only as good as the people who program it.

And this is the second part of the amazing computer revolution. For, as the computer has changed the operation of thousands of businesses and industries, it has also opened a huge new field of employment: the electronic data processing (EDP) field.

What does it take to enter this exciting new field of employment? What are the prospects for an EDP trainee? What can he or she expect in the way of salary, promotions, and future jobs?

The field of electronic data processing is one of the fastest growing employment fields in America today. More than half a million men and women are working in the EDP field at present, and the number of new jobs keeps growing every day.

Because the entire EDP field is so new, and because there are nowhere near enough EDP workers to fill every job, the rewards can be considerable. A programmer trainee, for example, can earn more than $6,000 a year. Within two years, he can earn at least $3,000 more. He can then move into more advanced levels of computer programming and, within a few more years, average between $12,000 and $15,000 a year.

The EDP field is exceedingly good for women. Some employers feel that women are better able to handle details, and in programming, attention to details is essential. The EDP field also offers good employment opportunities to minority groups and to people with physical handicaps.

As in any area of employment, some extra effort is required. First, you'll need to learn the special language of the computer. The two most commonly used computer languages are COBOL, or common-business-oriented language, and FORTRAN, or formula transition.

Second, you'll need to spend at least part of your time studying to keep up with the latest developments in the EDP field. Computers are constantly being improved and new programs are constantly being developed. Therefore, the worker who wants to get ahead must accept the fact that he'll spend the rest of his working life updating and improving his EDP knowledge and training.

Third, an EDP worker may find that he must work occasional evenings and weekends to get a particularly difficult job done. Yet, in spite of this, perhaps no other job field today offers as many opportunities and rewards.

If you are interested in an EDP career, will an employer be interested in you? The answer is yes, no matter what your race or sex. But his interest will result in a job only IF you are good with details, IF you are interested in solving problems in a step-by-step manner, IF you are willing to learn and keep on learning, and IF you have a high school diploma.

How will you start a career in EDP? You can begin in high school by taking courses in programming, computer math, and number systems. Presently, many high schools offer Future Data Processors (FDP) courses. These courses are prepared by the Data Processing Management Association, a group of employers who are eager to see students trained for a career in data processing.

But what if you are already out of high school? What about the many special trade schools which offer courses in EDP? Be careful! It is wise to check carefully into the school's reputation before you decide to attend. Remember, you will have to pay anywhere from several hundred to several thousand dollars to attend one of these schools. You will want to be sure you are getting your money's worth and receiving good training. Unfortunately, some schools don't always live up to their promise of getting you a job after you have finished their course of study.

Once you have completed some EDP training, either in high school or in a special training school, what next? You may start as a key punch operator, preparing the special punched cards which are fed into the computer. Or you may become a verifier, checking the punched cards to make sure they are accurate. Or you may take your first step into computer programming by becoming a coder. Here, you will change program steps into machine language instructions for the computer. Or perhaps you may become a computer operator on a beginning level. Within six months, you may move up to a higher level. And six months after that, you may become a Grade A computer operator, with several salary increases along the way.

From this point on, your career in EDP may move in any one of a number of directions. But the success of your career will depend on your abilities and the amount of additional education and training you are willing to acquire. In fact, one day you may find yourself in a job which, right now, hasn't even been developed. For, above all, the EDP field is constantly growing and changing. It offers unlimited future job possibilities because the future of the amazing computer itself is unlimited.

Computers have already affected the lives of each and every one of us in some way or another, and this is only the beginning. In the not-too-distant future, computers may drive our cars and trains, fly our airplanes, and build our buildings. They will probably teach us, shop for us, plan for us, entertain us. But the amazing thinking machine will always need people to feed it the information it must have and give it the proper instructions so it can do whatever must be done.

Your preview told you that this selection is about the computer and

.....a. how it was used to put men on the moon.
.....b. how it has opened up a whole new field of employment.
.....c. how it has been improved in the last twenty years.
.....d. the men who worked to develop it.

The answer to this question can be found on page 109.

Appendix 9

Sample Writing Materials - Child

Appendix III

List of Writing Materials Used in Data Collection Activities

Conventional and PBR

Tests of Academic Progress. (Grades 9, 11, 12)
Houghton, Mifflin Company, 1971.

Diagnostic Reading Scales, G. Spache. (Grades 6-8)
McGraw-Hill, 1963.

Selection 1 Part 1

The Medal of Honor is the highest and most rarely awarded decoration conferred by the United States. It was established by act of Congress, December 21, 1861, and is awarded in the name of Congress to an officer or enlisted man who, in actual conflict with the enemy, distinguishes himself conspicuously by gallantry and intrepidity at the risk of his life, and above and beyond the call of duty. A total of 2,105 Medal of Honor awards had been made as of June 30, 1947; of this number 1,721 were granted for gallantry between 1862 and January 1, 1918; 95 between January 1, 1918 and April 7, 1923, and 289 between December 7, 1941 and June 30, 1947.

Tests of Academic Progress. Boston:
Houghton Mifflin Company, 1971.
Page 48.

Selection 1 Part 2

The Medal of Honor is a five-pointed star, surrounded by a laurel wreath suspended from a bronze bar bearing the inscription, "For Valor," and is surmounted by an eagle. In the center of the star is a head of Minerva, encircled by the inscription, "United States of America." On the reverse of the medal is engraved the grade, name, and organization of the recipient, with the place and date of the act for which the award was granted.

Tests of Academic Progress. Boston: Houghton Mifflin Company, 1971. Page 48.

Selection 2 Part 1

Canada's Northwest Mounted Police was established in 1873 to bring law and order to the great unsettled area known as the Northwest Territory. Because this great area was controlled by roaming bands of criminals, it had become unattractive to permanent settlers.

In 1904 the prefix "Royal" was added to the name of the organization. In 1920 its name was again changed, this time to Royal Canadian Mounted Police, and it was given a new headquarters in Ottawa and responsibility for the enforcement of federal legislation throughout Canada.

In the 1930's marine and air divisions were added to the force. The "mounts" of today are generally automobiles rather than horses and the force has fine crime detection laboratories, finger print files, and other modern police equipment.

Tests of Academic Progress. Boston: Houghton Mifflin Company, 1971. Pages 48-49.

Selection 2 Part 2

An act of the Canadian Parliament created the police force and established specifications for its members. To be accepted, a candidate had to be in fine physical condition and of good character. He also had to be an excellent horseman and able to read and write either English or French. A force of about 300 members, with headquarters at Ft. Macleod, soon began to bring order to the area. The whiskey traffic that was ruining the Indians was stopped, and murderers, rustlers, and desperados were tracked down. The force also took responsibility for good government among the many settlers that now began to pour into the area. In addition it had to control the bands of Sioux Indians that had fled to Canada to escape U.S. forces intent on revenging Custer's Massacre.

Tests of Academic Progress. Boston:
Houghton Mifflin Company, 1971.
Page 48.

Grade 9 Post (PBR)

Selection 3 Part 1

From the time of the German invasion of Poland in 1939, the president's chief concern was foreign affairs. By the winter of 1940-41, Britain was becoming unable to pay cash for arms purchased in the United States. President Roosevelt took the position that if a neighbor's house was afire one would gladly lend him a fire hose to extinguish the blaze and, accordingly, began a policy known as "Lend-Lease."

This extension of actual financial aid to one side in a great war set off bitter debates between the interventionists and the isolationists. However, in the campaign of 1940, Roosevelt's opponent, Wilkie, also favored the Allied cause and Roosevelt became the first president to be elected to a third consecutive term of four years.

Tests of Academic Progress. Boston:
Houghton Mifflin Company, 1971.
Page 50.

Close Encounters

Project #710736
3/12/78

Another clap of thunder and orange light smashed at the house like a giant fist. The television set went on. So did the stereo. Electric lamps began to switch off and on. She could hear, in the vastness of her storage closet, the distant sound of her vacuum cleaner starting up.

Barry broke away from her grasp, ran to the window and sent the blind skyward with one happy swoop. As he did, a strange stillness fell on the place. The television and stereo were quiet. The vacuum cleaner stopped. There was no sound at all, not even of wind of the distant buzz of insects.

Then Jillian heard it. It sounded like ... claws.

On the roof. Scrambling across the shingles. Claws. Or talons. Long fingernails or toenails. Sharp, scurrying sounds.

She stared at the ceiling above her, eyes moving along in the direction of the scraping, scrambling noises. They stopped for a moment at the chimney.

And now they began to come down the chimney.

Jillian dashed into the living room and raced for the damper handle. At any cost, she had to shut the flue. Barry followed happily.

"Come in!" he shouted. "Come in!"

The clawlike sounds skittered down the inside of the chimney. Jillian dived at the damper, slammed it shut.

Instantly, a harsh roar of noise shook the house. Orange light flooded every corner of the room. All the window shades snapped up.

Jillian dropped to the floor, hands over her ears. The television was blaring away. On the stereo, the turntable was revolving. From the loudspeakers, Johnny Mathis was singing "Chances Are" in a huge voice like the growl of a lion.

Jillian ran for the telephone again, dragging Barry with her.

Eyes wide with fright now, she found Neary's number. As she held the telephone to her ear, instead of a dial tone, it gave forth the same five-note melody that Barry had been playing on his xylophone. Jillian jiggled the hook, got a tone like the angry zzz of bees, and dialed Neary's number. The room lights were doing strange things, dimming to a fitful smoky red, then flaring to a blue-white that hurt her eyes. The telephone was buzzing.

"Hello?" a woman asked.

"Roy?" Jillian's voice was a frightened croak.

"He's not here," Ronnie was matter-of-factly. "I'm his wife. Who's calling, please?"

The overload was so ferocious that even the air in the rooms seemed to burn

orange-hot with a fearful buzzing noise. It was as if some giant high-tension tower, carrying thousands of volts, had toppled down on this house and charged it so thickly with power that--

The vacuum cleaner, like a prisoner being tortured in a cell, screamed in horror. The stereo speakers vibrated and burst apart.

A metal ashtray rose into the air and hovered for an instant, suspended in the terrifying heat of the air. She could hear the clattering on the roof again.

Jillian lost track of what was happening. The phone dropped from her hand. She slid to the floor. Barry was nowh--

"Barry!"

Racing into the room like an auto run amok, the vacuum cleaner began howling across the floor, chasing her as she jumped out of its way. It wheeled, charged again. Jillian ran.

In the horror of crashing, grinding noises and flashing, blinding lights, Jillian lost track of what was happening. Barry was--

"Barry!"

Somewhere in the distance she could hear over everything Barry's gleeful laughter. The kitchen. Jill, beyond walking, started the endless crawl across the room to the kitchen.

The refrigerator was vibrating intensely. The door swung open, the light inside blinking on and off spastically.

Then she caught sight of her son. He, too, was crawling on the floor. Toward the dog-door opening. He reached it and started trying to wriggle through the narrow opening.

Jillian lunged forward and grabbed for Barry's foot. She caught it and started to haul him back in. She pulled hard. He slid across the linoleum toward her. The air smelled brassy and dank with electricity.

Then something pulled him away. Some force was tugging him outside the house.

"Let go of him!" she screamed.

Jillian gritted her teeth and pulled back. The boy's body shifted forward and back a few inches.

Jillian held on to her son until she felt, she knew, that if she did not let go, he would be dislocated. Sobbing, Jillian loosened her grip and Barry slipped away from her hands and out the little door.

In a flash, he was gone.

"Wouldn't this be a perfect time for a little music?" the ladybug asked. "How about it, Old Grasshopper?"

"With pleasure, dear lady," the Old-Green-Grasshopper answered, bowing from the waist.

"Oh, hooray! He's going to play for us!" they cried, and immediately the whole company sat themselves down in a circle around the Old Green Musician-and the concert began.

From the moment that the first note was struck, the audience became completely spellbound. And as for James, never had he heard such beautiful music as this! In the garden at home on summer evenings, he had listened many times to the sound of grasshoppers chirping in the grass, and he had always liked the noise that they made. But this was a different kind of noise altogether. This was real music-chords, harmonies, tunes, and all the rest of it.

And what a wonderful instrument the Old-Green-Grasshopper was playing upon. It was like a violin! It was almost exactly as though he were playing upon a violin!

The bow of the violin, the part that moved, was his back leg. The strings of the violin, the part that made the sound, was the edge of his wing.

He was using only the top of his back leg (the thigh), and he was stroking this up and down against the edge of his wing with incredible skill, sometimes slowly, sometimes fast, but always with the same easy flowing action. It was precisely the way a clever violinist would have used his bow; and the music came pouring out and filled the whole blue sky around them with magic melodies.

When the first part was finished, everyone clapped madly, and Miss Spider stood up and shouted, "Bravo! Encore! Give us some more!"

"Did you like that, James?" the Old-Green-Grasshopper asked, smiling at the small boy.

"Oh, I loved it!" James answered. "It was beautiful! It was as though you had a real violin in your hands!"

"A <u>real</u> violin!" the Old-Green-Grasshopper cried. "Good heavens, I like that! My dear boy, I <u>am</u> a real violin! It is a part of my own body!"

"But do <u>all</u> grasshoppers play their music on violins, the same way as you do?" James asked him.

"No," he answered, "not all. If you want to know, I happen to be a 'short-horned' grasshopper. I have two short feelers coming out of my head. Can you see them? There they are. They are quite short, aren't they? That's why they call me a 'short-horn'. And we 'short-horns' are the only ones who play our music in the violin style, using a bow. My 'long-horned' relatives, the ones who have long curvy feelers coming out of their heads, make their music simply by rubbing the edges of their two top wings together. They are not violinists, they are wing-rubbers. And a rather inferior noise these wing-rubbers produce, too, if I may say so. It sounds more like a banjo than a fiddle."

"How fascinating this all is!" cried James. "And to think that up until now I had never even <u>wondered</u> how a grasshopper made his sounds."

Appendix 11

Reading Behavior Observation and Factors Present in Oral Reading Forms

Name of Reader _____ Date _____

Grade _____ Birthdate _____ M _____ F _____

Years Reading Braille _____ Handedness _____

Name and type of material read for evaluation _____

_____

_____

This Evaluation of Oral _____ Silent _____ Reading (Check)

Posture: 1. Appropriate reading position, natural, relaxed, erect _____
2. Inappropriate reading position, slumped, tense, bent _____

Braille Material: 1. Read on desk _____
2. Read on table _____
3. Read on lap _____

Page Angle With Body: 1. Parallel _____
2. Acute on right _____
3. Acute on left _____

Page Turning: 1. Very efficient _____
2. Average _____
3. Awkward _____

Shift in Page Position: 1. Frequent _____
2. Occasional _____
3. Never or seldom _____

Handedness:
1. Uses right hand _____
2. Uses left hand _____
3. Uses both hands _____
4. Reads with one hand _____
   - Right hand with left idle _____
   - Right hand with left marking location of new line _____
   - Left hand with right idle _____
5. Reads with two hands _____
   - Keeps both hands together to complete line _____
   - Right completes line, left moves to new line and reads few words _____
   - Right completes line, left moves to new line and reads first half, hands meet briefly near middle of line _____

Wrists: 1. Relaxed _____
2. Humped _____

Reading Finger(s):
1. Index only _____
2. Index and second _____
3. Three or more fingers _____
4. Other fingers resting on reading line _____
5. Other fingers clenched _____

Finger Pressure:
1. Light _____
2. Heavy _____
3. Erratic _____

Rubs (scrubs) letters:
1. Often _____
2. Occasionally _____
3. Hardly ever _____

Retracings:
1. Frequent _____
2. Occasional _____
3. Never or seldom _____
4. Letters _____
5. One word _____
6. Phrase _____
7. Sentence or line _____

Loss of Place on Line:
1. Frequent _____
2. Occasional _____
3. Never _____

Return Sweep is:
1. Efficient _____
2. Hesitant _____
3. Very slow _____

Loss of Place in Return Sweep:
1. Frequent _____
2. Occasional _____
3. Never _____

Reading Accompanied with Silent Speech Movement (lips, larynx):
1. Often _____
2. Occasionally _____
3. Hardly ever _____

General Evaluation:
1. Reads fluently and with comprehension _____
2. Reads haltingly _____
3. Word calling _____
4. Lacks comprehension _____

FACTORS PRESENT IN ORAL READING SESSION

1. The child was:

   _____ a. uneasy

   _____ b. at ease

   _____ c. unconcerned

2. Motivation to do well was:

   _____ a. high

   _____ b. average

   _____ c. low

3. Quality of this performance was (as compared with usual performance, if known):

   _____ a. very superior

   _____ b. superior

   _____ c. average

   _____ d. below average

   _____ e. very poor

4. The material appeared to be of:

   _____ a. very high interest

   _____ b. high interest

   _____ c. average interest

   _____ d. little interest

   _____ e. no interest

5. The material seemed to be:

   _____ a. very easy

   _____ b. easy

   _____ c. average

   _____ d. difficult

   _____ e. very difficult

6. The child seemed to have most difficulty with (check those that apply):

_____ abbreviated words

_____ words with braille contractions

_____ words largely in full spelling

_____ names

_____ punctuation

_____ other

Comments: _____

_____

_____

7. The child read:

_____ a. in an even flow

_____ b. stopped and re-read words frequently

_____ c. made frequent retracings over the line he reads or larger part of it.

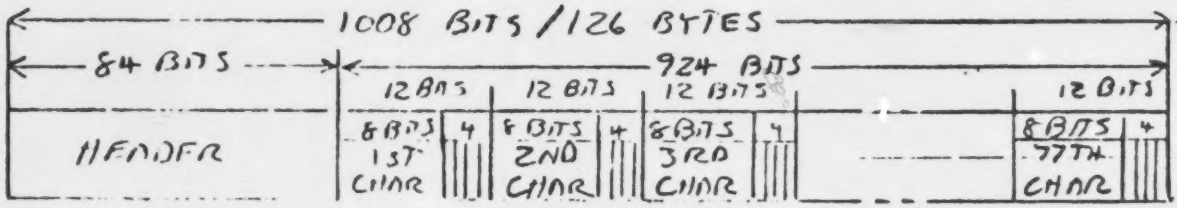
177 COPY
JOHN SNOWDEN

TABLE OF CONTENTS

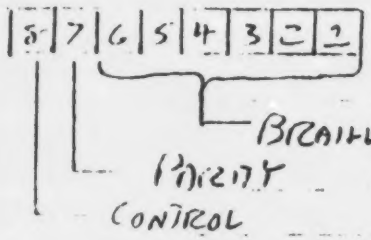
DESCRIPTION OF APH TAPES
DESCRIPTION OF ELINFA ASCII INTERFACE
CONVERSION TABLES
PL/I PROGRAM
SAMPLE APH TAPE OUTPUT
DESCRIPTION OF DUMPS
USE OF TSO AT OSU
SCHEDULE OF HOURS AT OSU
APH TAPE DUMP
EBCDIC TAPE DUMP
ASCII TAPE DUMP

APH TAPES

THE APH TAPES CONTAIN UNBLOCKED RECORDS OF 1008 BITS AT 556 BPI ON A 7-TRACK TAPE. THE FIRST 84 BITS ARE OF NO INTEREST AS THEY ARE PROBABLY CONTROL INFORMATION FOR THE METAL PLATE MACHINE. THE REMAINING 924 BITS CONTAIN THE BRAILLE TEXT. THERE ARE A POSSIBLE 77 CHARACTERS IN GROUPS OF 12 BITS. THE LOWER ORDER 4 BITS ARE NOT USED SO 8 BITS DEFINE A CHARACTER.



IF THE BITS FOR EACH CHARACTER ARE NUMBERED FROM THE LOW-ORDER BIT TO THE HIGH-ORDER BIT



THEN BIT 8 IS USED TO INDICATE A CONTROL FUNCTION, BIT 7 IS USED TO MAINTAIN EVEN PARITY FOR THIS BYTE & BITS 1-6 REPRESENT THE BRAILLE CELL.

1	4
2	5
3	6

THE CONTROL FUNCTIONS AND THEIR USAGE IS AS FOLLOWS:

BITS	HEX	USAGE
8-7	C0	BLANKS, NOT REALLY A CONTROL FUNCTION
8-1	81	LOGICAL END OF LINE, ANY REMAINING CHARACTERS ARE BLANKS
8-7-2-1	C3	END OF PAGE, IGNORED FOR THE ELINFA
8-3	83	END OF RECORD
8-7-6-5-4-3-2-1	FF	DELETED CHARACTER

APH Braille Output Tape

The braille output tape file contains text data resulting from computer translation of inkprint into braille at APH.

The tape is 7-track and is written with odd parity at a density of 556 bpi. Records have a length of 168 characters and are unblocked.

Braille text is represented by an 8-position code, positions 1 to 6 of which correspond to dots 1 to 6 of the braille cell. The 63 braille characters are specified by the appropriate information in positions 1 to 6 with the addition of position 7 to maintain even parity. Examples of these codes are:

a	7 1
b	2 1
c	4 1
d	7 5 4 1

Besides the codes for the braille signs, there are several control codes:

space or blank cell	8 7
end of line	8 1-
end of page	8 7 2 1
end of record	8 3
character deleted	8 7 6 5 4 3 2 1

The text consists of a continuous stream of characters so that braille lines overlap record boundaries. However, a new paragraph or a new page normally begins a new record. A record may contain from 1 to 73 braille characters, but most often contains 65 characters.

In the braille output tape is contained the data required for punching cards to operate automatic stereograph machines which make metal plates for embossing books or magazines. Since errors detected in proofreading are corrected in the plates but not on the tape, it is important to note that the tape file may not correspond exactly with the published translation and may contain some errors.

The significance of the 6 positions (bits) of each of the 168 characters of a record is as follows:

ELINFA ASCII INTERFACE

The ELINFA Digicassette can send and receive messages in braille. Various devices converted to accept braille codes can be operated directly from the Digicassette (adaptable calculators, the adaptable I.B.M. "Selectric" typewriter, other Digicassettes). The ELINFA ASCII interface converts braille characters produced by the Digicassette into computer-readable characters and converts computer-generated characters into Digicassette-readable braille characters. Once connected to the ELINFA interface, the Digicassette is seen by the computer as an ordinary computer terminal, and by the user as a computer terminal equipped with a braille keyboard and a braille display. The ELINFA interface is provided with a buffer memory in which more than one page of braille can be stored and retrieved (2-page option also available).

ASCII TO BRAILLE CODE CONVERSION

The most frequently used code in data transmission to and from computers is the 128-character ASCII code. Each ASCII character is represented by a 7-bit code. This 7-bit code is a binary representation of a decimal number between 0 and 127, called the decimal value of that ASCII character. ASCII characters with decimal value 0 through 31 are called control characters. They do not print on ordinary computer terminals but control the operation of the terminal. ASCII characters with decimal value 32 through 63 represent punctuation marks, some mathematical signs (plus, minus, etc.), and the numerals 0 through 9. ASCII characters with decimal value 64 through 95 represent the twenty-six capital letters A through Z and some more mathematical signs. ASCII characters with decimal value 96 through 126 represent the twenty-six lower case letters a through z and some other signs. The ASCII character with decimal value 127 is a non-printing 'delete' sign.

ELINFA ASCII INTERFACE

The ELINFA Digicassette can send and receive messages in braille. Various devices converted to accept braille codes can be operated directly from the Digicassette (adaptable calculators, the adaptable I.B.M. "Selectric" typewriter, other Digicassettes). The ELINFA ASCII interface converts braille characters produced by the Digicassette into computer-readable characters and converts computer-generated characters into Digicassette-readable braille characters. Once connected to the ELINFA interface, the Digicassette is seen by the computer as an ordinary computer terminal, and by the user as a computer terminal equipped with a braille keyboard and a braille display. The ELINFA interface is provided with a buffer memory in which more than one page of braille can be stored and retrieved (2-page option also available).

ASCII TO BRAILLE CODE CONVERSION

The most frequently used code in data transmission to and from computers is the 128-character ASCII code. Each ASCII character is represented by a 7-bit code. This 7-bit code is a binary representation of a decimal number between 0 and 127, called the decimal value of that ASCII character. ASCII characters with decimal value 0 through 31 are called control characters. They do not print on ordinary computer terminals but control the operation of the terminal. ASCII characters with decimal value 32 through 63 represent punctuation marks, some mathematical signs (plus, minus, etc.), and the numerals 0 through 9. ASCII characters with decimal value 64 through 95 represent the twenty-six capital letters A through Z and some more mathematical signs. ASCII characters with decimal value 96 through 126 represent the twenty-six lower case letters a through z and some other signs. The ASCII character with decimal value 127 is a non-printing 'delete' sign.

Since the braille cell contains only six dots, there are only 64 different braille characters (including space), compared with 128 ASCII characters (including space). The ELINFA interface provides three switchable options for ASCII to braille conversion:-

OPTION A: LIMITED ASCII CODE CONVERSION. In this option, any ASCII character with decimal value 32 through 63 and 96 through 127 is represented by one braille character. (See CONVERSION TABLE, below). Any ASCII character with decimal value 64 through 95 is represented as if it were the character obtained by adding 32 to the original decimal value. Example: K (decimal value 75) is represented in the same way as k (decimal value 107 or 75 + 32). ASCII control characters are ignored.

OPTION B: FULL ASCII CODE CONVERSION. In this option, one braille character has been selected for use as a prefix. All ASCII characters with decimal value 32 through 63 and 96 through 127, except one, are represented by the same braille characters as in Option A. The ASCII character not represented in braille is the one for which the braille prefix sign was used in Option A. Any ASCII character with decimal value 64 through 95 will now be represented by two braille characters: the prefix followed by the braille character representing the ASCII character obtained by adding 32 to its decimal value. Example: K (decimal value 75) is now represented in braille by the prefix followed by k, so that the prefix acts like a capital sign. Any ASCII character with decimal value 0 through 31 will be represented in the same way. Example: line feed (control character, decimal value 10) is represented in braille by the prefix followed by an asterisk (decimal value 42 or 10 + 32); carriage return (decimal value 13) is represented by the prefix followed by a minus sign (decimal value 45). When using Option B, all control characters can be displayed in braille and recorded on a cassette tape.

OPTION C: PARTIAL ASCII CODE CONVERSION. In this option, all ASCII control characters are ignored. The remaining ASCII characters are represented as in Option B.

DESCRIPTION

1. EXTERNAL CONTROLS AND CONNECTIONS

(a) Top Panel. Upper part: power on

Left sliding switch up = ~~full ASCII in transmission (code conversion B)~~

down = ~~limited ASCII in transmision (code conversion A~~ power off

Right sliding switch up = prefix for capital letters

down = no prefix

Top Panel. Lower part:

Left key = not used

Center key = memory reset

Right key = memory read

(b) Rear Panel.

Left = 25-pin RS-232 connector (male)

Right = charger plug

(c) Left Panel = 9-pin connector(male) to connect the interface t
the Digicassette

2. INTERNAL CONTROLS AND CONNECTIONS

(a) Upper Printed Circuit

Two sliding switches to allow independent setting of transmission (out) an
reception (in) speeds between 2400 bauds (far left) and 150 bauds.

(b) Lower Printed Circuit

Right upper side = a sliding switch to change from RS-232 (left) to
20 mA current loop operation (right)

Left upper side. =

1 (brown) up = control characters ignored

down = control characters received with prefix

2 (red) up = odd parity

down = even parity

3 (orange) up. = parity bit

down = no parity bit

4 (yellow) up = two stop bits

down = one stop bit

The ELINFA interface can be used in three basic ways: data reading mode, data recording mode, and dialogue mode. Every braille character coming from the Digicassette is converted into an ASCII character and sent to the device connected to the RS-232 plug. Transmission always in free ASCII (mode B) If the interface receives a prefix from the Digicassette, an ASCII character will only be sent when the interface receives a second braille character following the prefix. Each ASCII character received from the external device is converted into one or two braille characters (depending on the code switches' positions), stored in the interface's memory, and, if the Digicassette is free, sent to the Digicassette's memory and braille display. If the Digicassette is already in use, the braille characters produced from the ASCII characters received will be stored in the interface's memory and then sent to the Digicassette, in order of arrival, as soon as the Digicassette is free. If the number of braille characters waiting in the interface's memory reaches the maximum memory capacity, a stop-character can be sent by the interface to the external device. A start-character can be sent in the same way by the interface as soon as space becomes available in its memory. These stop- and start-characters can be chosen by the user and must be factory-wired in the interface.

To prevent loss of characters when the external device is transmitting characters at a speed greater than the average storage recording speed (35 characters per second), the user must either use this feature of the interface, or limit the length of each message coming from the external device to match the interface's memory capacity; enough time must be provided between two adjoining messages to keep the average transmission speed at or below 35 braille characters per second.

To start operating the Digicassette with the interface, proceed always in the following order:-

(a). Connect the interface to the Digicassette.
(b) Connect the external device to the interface.
(c) Switch on the interface.
(d) Switch on the Digicassette.

---

1. **DATA READING MODE. In this mode, data stored in braille on the cassette tape can be transmitted to the computer either automatically or manually.**

Manual operation allows the user to proofread each line sent to the computer on the braille display, as follows:-

(a) Slide the Digicassette's rear switch into the manual (up) position and set the machine for reading (playback). Now press the tape motion key (T). As soon as the first block of 120 characters is read from the cassette tape, the first line of the block is displayed and sent to the interface. Touch the touch switch, and the second line will be displayed and sent to the interface. Proceed in the same manner to read the whole tape.

(b) For automatic operation, set the Digicassette for reading and slide the rear switch into the automatic (down) position. Now press the tape motion key (T). As soon as the first block has been read from the cassette tape, this block and the following ones will be sent automatically to the interface and to the external device, but will not appear on the braille display of the Digicassette. Automatic transmission will stop if a block has not been read properly (warning tone). To resume transmission, just proceed as if you were reading braille from a cassette.

(c) To go from manual to automatic transmission, slide the rear switch downward and touch the touch switch. To stop automatic transmission, slide the rear switch upward.

2. DATA RECORDING MODE. In this mode, data sent by the computer will be recorded in braille on the cassette tape, as follows:-

(a) Set the Digicassette for writing (recording), slide the rear switch to automatic. As with any writing operation, be sure that the tape is set at the spot where the recording is to start.

(b) Transmission must be initiated from the external device. When the

Digicassette receives characters from the interface, a rapid movement of the dots on the braille display will be observed. When the rapid movement stops, this means that the braille characters are being sent from the Digicassette's buffer memory to the cassette tape. During this transmission, the last 12 characters of the block are displayed in braille.

3. DIALOGUE MODE. In this mode, the external device will send a message, generally called a reply after having first received a message, generally called a question, sent by the Digicassette and written on its braille keyboard. Both the questions and the replies can, at will, be recorded in braille on the cassette tape. A message coming from the external device should never exceed the interface's memory capacity; otherwise, you will have to proceed as in Sub-paragraph 2 (Data Recording Mode).

(a) The Digicassette must be set for writing (recording) with the rear switch in the manual position.

(b) Write the first question, using the Digicassette's braille keyboard. Do not use backspace key (R) to correct a mistake, but write the proper control character, if available. Each time the Digicassette's memory is filled (warning "beep"), press reset key (Z); or, press tape motion key (T) if you want to keep a permanent record of your questions.

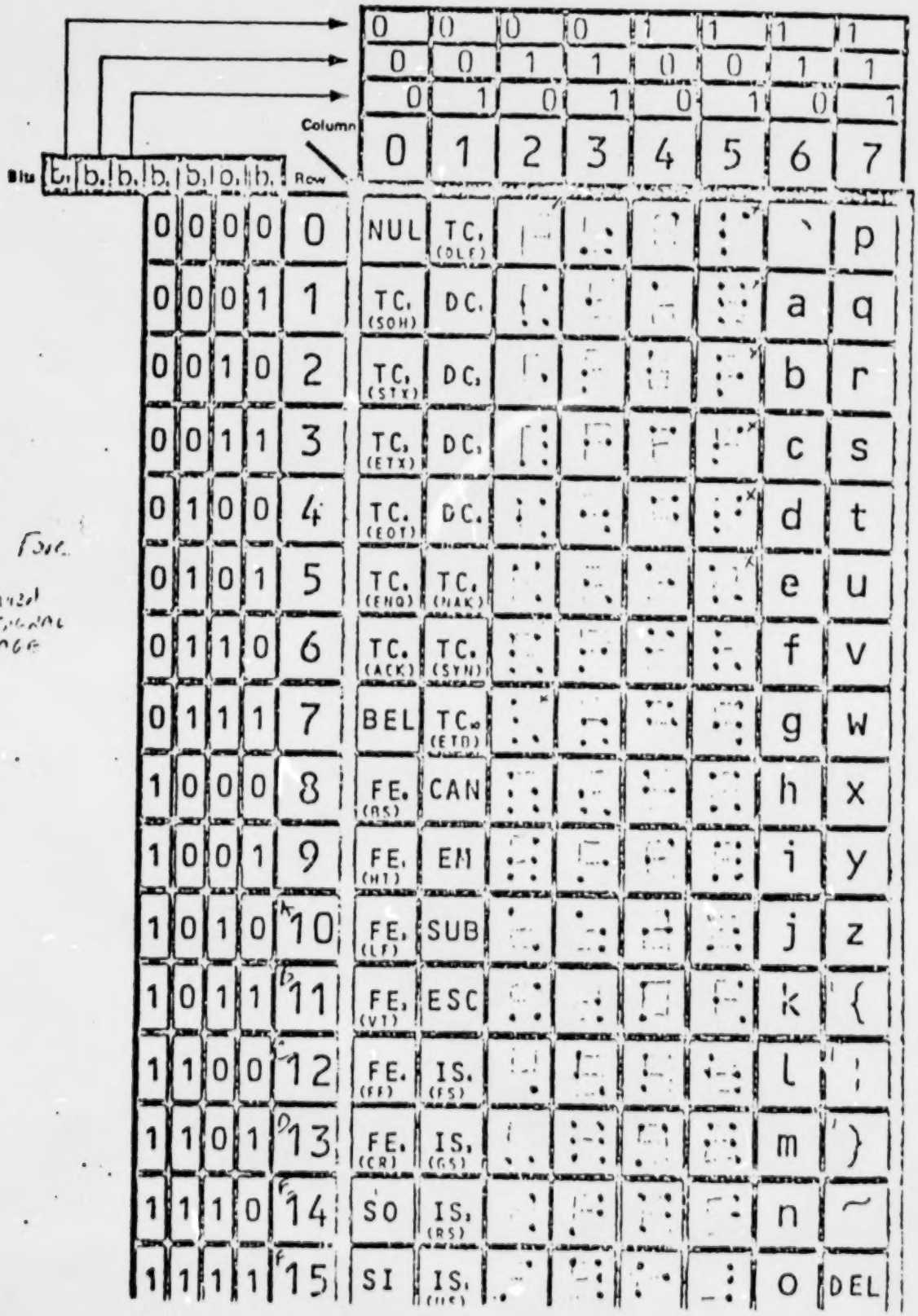
(c) The incoming reply from the external device will produce a rapid movement of the dots on the braille display. This rapid movement will stop at the end of the reply or as soon as the Digicassette's memory is full (warning "beep"). To read the reply, press reset key (Z) and touch the touch switch as necessary. If the Digicassette's memory has been filled, press key T to receive the rest of the reply and then key Z to read it as soon as the rapid movement of the braille display stops. If the last part of the previous question is still in the Digicassette's buffer memory when the reply is

being recorded, then both the reply and the last part of the question will be recorded. If you press the interface's memory reset key after the last character of a question has been written, the reply will be stored in the interface's memory, beginning at location 0, and can then be reread as many times as necessary by using the interface's memory read key.

4. INTERFACE SELF-TEST. A test plug is provided with the ELINFA interface, allowing the user to test for proper operation and setting of the interface without the need for any external device. This test plug simply sends back to the interface any ASCII character transmitted by the interface.

To perform the test, insert the test plug into the 25-pin connector on the rear panel of the interface, and then proceed as in Sub-paragraph 3 (Dialogue Mode). Each character written on the braille keyboard will immediately be sent back to the Digicassette and hence will appear twice on the braille display. This character will also be stored in the interface's memory and can be reread from the memory by using the interface's memory read key. During a test of this kind, do not forget to press key Z or key T as soon as the Digicassette's memory is filled (warning "beep").

5. ASCII TO BRAILLE CONVERSION TABLE. ELINFA interfaces available in the United States use a code conversion identical to the one used by Triformation for the LED-120 braille printer. By switching the ELINFA interface to Code Conversion A (Limited ASCII), any message which has been prepared for printing on the LED-120 can be recorded directly onto a cassette tape.



Bits b_7 b_6 b_5	000	001	010	011	100	101	110	111
b_4 b_3 b_2 b_1 (Row) \ Column	0	1	2	3	4	5	6	7
0 0 0 0 0	NUL	TC$_1$ (DLE)					`	p
0 0 0 1 1	TC$_1$ (SOH)	DC$_1$					a	q
0 0 1 0 2	TC$_2$ (STX)	DC$_2$					b	r
0 0 1 1 3	TC$_3$ (ETX)	DC$_3$					c	s
0 1 0 0 4	TC$_4$ (EOT)	DC$_4$					d	t
0 1 0 1 5	TC$_5$ (ENQ)	TC$_8$ (NAK)					e	u
0 1 1 0 6	TC$_6$ (ACK)	TC$_9$ (SYN)					f	v
0 1 1 1 7	BEL	TC$_{10}$ (ETB)					g	w
1 0 0 0 8	FE$_0$ (BS)	CAN					h	x
1 0 0 1 9	FE$_1$ (HT)	EM					i	y
1 0 1 0 10	FE$_2$ (LF)	SUB					j	z
1 0 1 1 11	FE$_3$ (VT)	ESC					k	{
1 1 0 0 12	FE$_4$ (FF)	IS$_4$ (FS)					l	|
1 1 0 1 13	FE$_5$ (CR)	IS$_3$ (GS)					m	}
1 1 1 0 14	SO	IS$_2$ (RS)					n	~
1 1 1 1 15	SI	IS$_1$ (US)					o	DEL

For

USED TO SIGNAL
OF MESSAGE

TAPE (OCTAL)	BRAILLE (ELINFA)	GRAPHIC (LOWER CASE)	ASCII (HEX)	TAPE (OCTAL)	BRAILLE (ELINFA)	GRAPHIC (LOWER CASE)	ASCII (HEX)
00		BLANK	20	40		J	2C
01		A	61	41		*	2A
02		1	31	42		5	35
03		B	62	43		<	3C
04	[2]	NONE	NONE	44		-	2D
05		K	6B	45		U	75
06		2	32	46		8	38
07		L	6C	47		V	76/27
10		@	40	50		.	2E
11		C	63	51		%	25
12		I	69	52		{	5B
13		F	66	53		B	24
14		/	2F	54		+	2B
15		M	60	55		X	58
16		S	73	56		!	21
17		P	70	57		&	26
20		"	22	60		;	3B
21		E	65	61		:	3A
22		3	33	62		4	34
23		H	68	63		\	5C
24		9	39	64		0	30
25		O	6F	65		Z	7A
26		6	36	66		7	37
27		R	72	67		(	28
30		^	5E	70		_	5F
31		D	64	71		?	3F
32		J	6A	72		W	77
33		G	67	73		]	5D
34		>	3E	74		#	23
35		N	6E	75		Y	79
36		T	74	76		)	29
37		Q	71	77		=	30

[1] HIGHER ORDER BITS ARE USED ONLY FOR CONTROL. LOW ORDER 6 BITS DEFINE A CHARACTER. CONTROL CHARACTERS ARE

APH TAPE (HEX)	FUNCTION
81	END OF LINE
C3	END OF PAGE
83	END OF RECORD
FF	CHARACTER DELETED

[2] THE BRAILLE CHARACTER ⠗ CAN NOT BE DISPLAYED ON THE ELINFA

[3] THE BRAILE CHARACTER ⠗ CAN BE DISPLAYED ON THE ELINFA BY TRANSMITTING A V (ASCII 56) OR ASCII 27.

[4] THE CHARACTER "," (ASCII 2C) IS USED TO SIGNIFY UPPER CASE. A SINGLE OCCURANCE, NEXT CHARACTER IS UPPER CASE. A DOUBLE OCCURANCE, ALL CHARACTERS TO NEXT BLANK ARE UPPER CASE.

BRAILLE

```
0   BRAILLE:  PROC OPTIONS(MAIN);
0   DCL TAPE FILE RECORD INPUT,
0       ISOTAPE EXTERNAL ENTRY(CHAR(*),CHAR(*)),
0       1 IN_BUFF ALIGNED,
0        2 CRTP BIT(31) UNALIGNED,
0        2 TEXT(72) UNALIGNED,
0          4 CI BIT(8), 4 JUNK BIT(4),
0       OUT_BUFF CHAR(73) STATIC,
0       (CHAR,DELETE,BLANK,END_RECORD,END_LINE,END_PAGE) CHAR(1) STATIC,
0       MORE_INPUT BIT(1) STATIC,
0       XLATE_TBL CHAR(256) STATIC INIT(
0   ' a1b k2l0c1f/ms p"e3h9o6r^d,j&>nkq,*5<-uuv.z(+:=!&;:4\0x?(_?w)1=) ');
0   BLANK = LOW(1);
0   DELETE = HIGH(1);
0   UNSPEC(END_LINE) = '10000001'B;
0   UNSPEC(END_PAGE) = '11000011'B;
0   UNSPEC(END_RECORD) = '10000100'B;
0   SUBSTR(XLATE_TBL,65,64) = SUBSTR(XLATE_TBL,1,64);
0   SUBSTR(XLATE_TBL,129,64) = SUBSTR(XLATE_TBL,1,64);
0   SUBSTR(XLATE_TBL,193,64) = SUBSTR(XLATE_TBL,1,64);
0   ON ENDFILE(TAPE) MORE_INPUT = '0'B;
0   MORE_INPUT = '1'B;
0   READ FILE(TAPE) INTO(IN_BUFF);
0   DO WHILE(MORE_INPUT);
0     DO I = 1 TO 72;
0       UNSPEC(CHAR) = CI(I);
0       SELECT (CHAR);
0         WHEN (END_LINE, END_PAGE, DELETE) SUBSTR(OUT_BUFF,I,1) = BLANK;
0         WHEN (END_RECORD) K = I;
0         OTHERWISE SUBSTR(OUT_BUFF,I,1) = CHAR;
0       END;
0     END;
0     OUT_BUFF = TRANSLATE(OUT_BUFF,XLATE_TBL);
0     IF SUBSTR(OUT_BUFF,1,4) ^= '    '
0     /*THEN CALL ISOTAPE(SUBSTR(OUT_BUFF,1,K-1),'CN');*/
0       THEN PUT SKIP EDIT(SUBSTR(OUT_BUFF,1,K-1))(A);
0     READ FILE(TAPE) INTO(IN_BUFF);
0   END;
0   END BRAILLE;
OF DATA
```

B(84), 77(13(8), 13(4))

REMOVE PAGE HEADINGS

PH TAPE DCB=(RECFM=F, LRECL=126, TRTCH=C, DEN=1)

THREE TAPE DUMPS ARE INCLUDED. THE FIRST IS A HEX DUMP OF THE ORIGINAL APH TAPE. THE SECOND IS A HEX DUMP OF THE FIRST FILE OF THE TAPE PREVIOUSLY SENT. THIS FILE IS THE RESULT OF A PROGRAM SIMILIAR TO THE PWI [illegible]GRAM SHOWN EARLIER. THE OUTPUT CHARACTER SET IS EBCDIC. THE THIRD DUMP IS THE SAME FILE TRANSLATED TO ASCII. IT WAS DUMPED FROM THE SECOND FILE OF THE TAPE SENT PREVIOUSLY.

LOWER CASE - USER
UPPER CASE - SYSTEM

(614) -422-3950
ANY ASCII TERMINAL
AT 30 CPS

```
logon@
USERID? cs0842/pbrbeh id(322167017)@
TERMINAL ID? @
UNKNOWN TERMINAL ID
TERMINAL ID? @
UNKNOWN TERMINAL ID
TERMINAL ID?@
UNKNOWN TERMINAL ID
TS0842 LOGON IN PROGRESS AT 09:28:27 ON SEPTEMBER 26, 1978
READY
userp proc.clist @
READY
copy braille.data 'oneday.ash.test.book1'@@z
READY

braille test 1 @
 ,pi)mont ,/reet has alw be5 ! same4 ,cottonwood popl>s drop _! r$ 8worms0


ATTENTION
READY
logoff @
0EF201I CSU=  2  CPU=00:00:01.51  SYSO=  0  DSK=  284  CNCT=00:03  CHGS=
  $1.59  ACCT BAL=  $478.66
TS0842 LOGGED OFF TSO AT 09:30:59 ON SEPTEMBER 26, 1978
```

ONLY ONCE PER DAY

THE SYMBOL @ IS REQUIRED TO SEND AN "END OF LINE" SYMBOL TO THE COMPUTER. ON AN ASCII TERMINAL, THIS IS THE "RETURN KEY". ON THE ELINFA THIS REQUIRES TWO CHARACTERS " " TO TERMINATE A LINE.

Appendix 13

Computer-Tape Translation Procedures

One method of producing braille reading cassettes for use with the Digicassette has been explored at George Peabody College for Teachers, Nashville, Tennessee. Computer-generated braille tapes from the American Printing House for the Blind, Louisville, Kentucky, have been used to produce braille reading cassettes for the Digicassette. A specific program, translating the APH computer tape into an acceptable computer language for the Digicassette, was written by James Hogge, Ph.D. The use of this program and Peabody's computer facilities, enabled project staff to produce braille cassettes for use with the Digicassette.

Three problems exist with the present translation scheme: 1) the APH tapes are recorded on 7-track mag tapes; as most computer facilities accept 9-track mag tapes, the APH tapes have to undergo a 7-to-9 track conversion; 2) the APH tapes contain the original input data, which has not been proofread or corrected; consequently, the possibility of braille character errors exists, however, the actual number of errors varies as a function of the specific text on the tape; and 3) due to the necessity of using existing braille characters for certain computer-specific symbols, one character, the apostrophe, does not translate into dot 3 as it should. Instead, the space where the apostrophe should be is left blank on the Digicassette.

A. The Program. The following programs were written specifically for the Peabody PDP computer. Modification may be necessary to obtain desired results with other systems.

```
0!      E L I N F A . B A S          ROUTINE TO TRANSMIT ASCII
                                     VERSION OF APH BRAILLE TAPE
                                     TO ELINFA BRAILLE RECORDER
0!      J. HUGGE
        GEORGE PEABODY COLLEGE FOR TEACHERS
        NASHVILLE, TN 37203
0!      20-NOV-78

00      ON ERROR GO TO 110
        \ PRINT 'FILE';
        \ INPUT LINE FS
        \ FS = CVT$$(FS,4%)
        \ OPEN FS FOR INPUT AS FILE 1%
        \ GO TO 140
10      IF  ERR <> 5%  THEN 120
                ELSE
                PRINT 'FILE NOT FOUND!'
                \ RESUME 100
20      IF  ERR <> 2%  THEN 130
                ELSE
                PRINT 'ILLEGAL FILE NAME!'
                \ RESUME 100
30      PRINT 'ERROR NUMBER'; ERR; 'AT LINE'; ERL
        \ RESUME 32767
40      OPEN 'KB:' FOR INPUT AS FILE 2%
50      INPUT 'SIDE AT WHICH TO BEGIN TEXT TRANSMISSION'; S1%
60      PRINT 'PRESS RETURN TO BEGIN.';
70      INPUT LINE #2%, A$
80      PRINT STRING$(500%,42%)
90      ON ERROR GO TO 560
        \ N = 0.0
00      S% = 1%
10      PRINT ' ,CASSETTE SIDE 1. ';
20      INPUT LINE #1%, T$
30      A% = INSTR(10%,T$,'    ')
        \ T$ = CVT$$(LEFT(T$,A%-1%),156%)
        \ N = N + LEN(T$)
        \ PRINT T$;
40      PRINT
50      INPUT LINE #1%, A$
60      A$ = LEFT(A$,70%)
70      IF  LEFT(A$,4%) <> '    '  THEN 310
80      A% = INSTR(10%,A$,'    ')
        \ IF  A% = 0%  THEN 310
90      B% = INSTR(A%,A$,'#')
        \ IF  B% = 0%  THEN 310
00      A$ = RIGHT(A$,B%+2%)
10      A$ = CVT$$(A$,20%)
20      N = N + LEN(A$)
30      IF  S% < S1%  THEN 360
40      PRINT
50      PRINT A$;
60      IF  N < 149000.0  THEN 250
70      ON ERROR GO TO 470
80      PRINT ' ,END OF CASSETTE SIDE'; S%; '   ';
```

```
390     PRINT '?????????????????????????????????????????????????????????????'
400     FOR  K% = 1% TO 3%
410             PRINT CHR$(7%);
420             SLEEP 1
430     NEXT K%
440     WAIT 10
450     INPUT #2%, A$
460     WAIT 0
        \ GO TO 480
470     IF  ERR <> 15%  THEN  ON ERROR GO TO 0
                ELSE
                RESUME 400
480     PRINT STRING$(500%,42%)
490     ON ERROR GO TO 560
        \ N = 0.0
500     N = N + LEN(T$)
510     S% = S% + 1%
520     PRINT ' ,CASSETTE SIDE';
530     PRINT CVT$$(NUM$(S%),128%); '. ';
540     PRINT T$;
550     GO TO 250
560     IF  ERR <> 11%  THEN 680
                ELSE
                RESUME 570
570     ON ERROR GO TO 670
580     PRINT ' ,END OF LAST CASSETTE SIDE. ';
590     PRINT '?????????????????????????????????????????????????????????????'
600     FOR  J% = 1% TO 10%
610             PRINT CHR$(7%);
620             SLEEP 1
630     NEXT J%
640     WAIT 10
650     INPUT #2%, A$
660     GO TO 32767
670     IF  ERR <> 15%  THEN  ON ERROR GO TO 0
                ELSE
                RESUME 600
680     IF  ERR <> 13%  THEN 690
                ELSE
                IF  ERL = 220%  THEN  RESUME 230
                        ELSE
                        RESUME 260
690     ON ERROR GO TO 0
32767   END
```

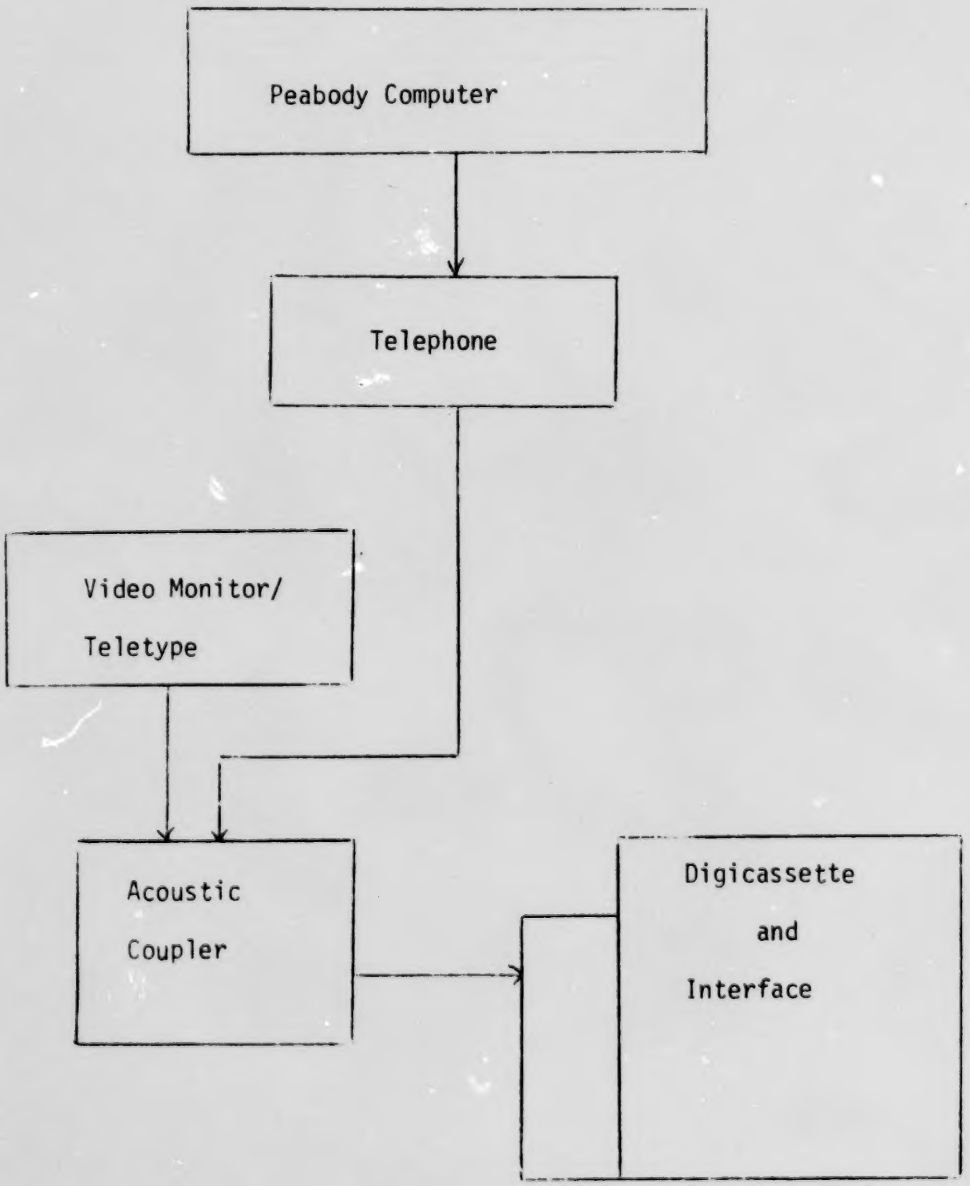
```
10      EXTEND!          B R A I L E . B A S

                         ROUTINE TO READ 9-TRACK VERSION
                         OF "BRAILLE TAPE" FROM APH AND
                         CONVERT IT TO ASCII FILE
20!     J. HOGGE
        GEORGE PEABODY COLLEGE FOR TEACHERS
        NASHVILLE, TN 37203
30!     14-NOV-78

100     PRINT
        \ PRINT 'APH TAPE CONVERSION'
110     DIM BYTE%(126%), TABLE%(63%), CHAR%(77%)  !

        ARRAY DEFINITIONS:

        BYTE%    NUMERIC VALUES OF BYTES READ FROM EACH
                 RECORD OF TAPE BEFORE CONVERSION

        TABLE%   NUMERIC VALUES OF ASCII CHARACTERS
                 CORRESPONDING TO "APH CHARACTERS" READ
                 FROM UNCONVERTED APH TAPE (E.G.,
                 TABLE%(I%) CONTAINS THE NUMERIC VALUE
                 OF THE ASCII CHARACTER CORRESPONDING TO
                 THE "APH CHARACTER" WITH NUMERIC VALUE
                 I%)

        CHAR%    NUMERIC VALUES OF ASCII CHARACTERS
                 AFTER PROCESSING THROUGH TABLE%

120     READ TABLE%(I%)  FOR  I% = 0% TO 63%
130     DATA 32,65,49,66,32,75,50,76,64,67,73,70,47,77,83,80
140     DATA 34,69,51,72,57,79,54,82,94,68,74,71,62,78,84,81
150     DATA 44,42,53,60,45,85,56,86,46,37,91,36,43,88,33,38
160     DATA 59,58,52,92,48,90,55,40,95,63,87,93,35,89,41,61
162!
        THE NEXT SEQUENCE CONVERTS THE NUMERIC VALUES OF LOWER-CASE
        LETTERS TO THE NUMERIC VALUES OF UPPER-CASE LETTERS.

164     FOR  I% = 1% TO 63%
                \ IF  TABLE%(I%) >= 65%  AND  TABLE%(I%) <= 90%
                        THEN  TABLE%(I%) = TABLE%(I%) + 32%
166     NEXT I%

170     ON ERROR GO TO 190
        \ PRINT
        \ PRINT 'OUTPUT FILE';
        \ INPUT LINE F$
        \ F$ = CVT$$(F$,4%)
        \ OPEN F$ FOR INPUT AS FILE 2%
        \ INPUT 'FILE ALREADY EXISTS!  DELETE'; A$
        \ IF  ASCII(A$) <> 89%  THEN 170
180     OPEN F$ FOR OUTPUT AS FILE 2%
        \ GO TO 210
190     IF  ERR <> 5%  THEN 200
```

```
                ELSE
                RESUME 180
200         IF  ERR <> 2%  THEN  ON ERROR GO TO 0
                ELSE
                PRINT 'INVALID FILE NAME!'
                \ RESUME 170
210         ON ERROR GO TO 220
            \ OPEN 'MT0:' FOR INPUT AS FILE 1%, RECORDSIZE 126%
            \ FIELD #1%, 126% AS T$
            \ GO TO 240
220         IF  ERR <> 8%  THEN 230
                ELSE
                PRINT
                \ PRINT 'THE MAGTAPE DRIVE IS ASSIGNED TO ' +
                        'ANOTHER JOB!'
                \ CLOSE 2%
                \ KILL F$
                \ RESUME 32767
230         ON ERROR GO TO 0
240         CHAR%(0%) = 77%
            \ ON ERROR GO TO 500
            \ PRINT
            \ PRINT 'CONVERSION UNDER WAY...'
            \ PRINT
250         GET #1%
            \ F% = 0%
260         CHANGE T$ TO BYTE%
            \ N% = 10%  !

            BECAUSE THE ORIGINAL INFORMATION IN THE "APH CHARACTER
            SET" CROSSES BYTE BOUNDRIES IN THE INPUT BUFFER, WE
            MUST ENGAGE IN MANIPULATIONS AT THE BIT LEVEL.

270         FOR  I% = 2% TO 76% STEP 2%
                \ N% = N% + 3%  !

                SOME VALUES REPRESENT CONTROL FUNCTIONS:

                129%    END OF LINE
                195%    END OF PAGE
                131%    END OF RECORD
                255%    CHARACTER DELETED

280             IF  BYTE%(N%) <> 129%  AND
                    BYTE%(N%) <> 195%  AND
                    BYTE%(N%) <> 131%  AND
                    BYTE%(N%) <> 255%  THEN 290
                        ELSE
                        CHAR%(I%) = 32%
                        \ GO TO 300  !  (32% = BLANK)

                IN THE NEXT STATEMENT 63% IS USED AS A "MASK" TO
                DISCARD THE TWO LEFT-MOST BITS, SINCE ONLY THE LAST
                SIX BITS DEFINE A CHARACTER.
```

```
290             CHAR%(I%) = TABLE%(BYTE%(N%) AND 63%)

300         NEXT I%
310         N% = -1%
320         FOR  I% = 11% TO 125% STEP 3%
                \ N% = N% + 2%  !

                15% IS USED AS A "MASK" TO LEAVE US WITH
                ONLY THE RIGHT-MOST FOUR BITS; 240% GIVES
                US THE LEFT-MOST FOUR BITS.  FINALLY, C%
                IS THE NEW BYTE WE HAVE ASSEMBLED.

330             A% = BYTE%(I%) AND 15%
                \ B% = BYTE%(I%+1%) AND 240%  !

                MULTIPLICATION BY 16% SHIFTS THE BITS FOUR
                POSITIONS TO THE LEFT; DIVISION BY 16%
                SHIFTS THE BITS FOUR POSITIONS TO THE RIGHT.

340             C% = A% * 16% + B% / 16%  !

                AS ABOVE, WE NEED TO INTERCEPT A CONTROL
                CHARACTER AND CONVERT IT TO A BLANK.

350             IF  C% <> 129%  AND  C% <> 195%  AND
                    C% <> 131%  AND  C% <> 255%  THEN 360
                        ELSE
                        CHAR%(N%) = 32%
                        \ GO TO 370  !  (32% = BLANK)

                AGAIN, WE MASK OFF THE LEFT-MOST TWO BITS.

360             CHAR%(N%) = TABLE%(C% AND 63%)

370         NEXT I%
            \ CHANGE CHAR% TO B$  !

            IF AN ERROR HAS OCCURRED IN READING THE TAPE RECORD,
            WE APPEND AN "X" TO THE OUTPUT RECORD.

380         IF  F% = 0%  THEN  PRINT #2%, B$
                    ELSE
                    PRINT #2%, B$; TAB(80%); 'X'
390         GO TO 250
500         IF  ERR = 11%  THEN  RESUME 600
                    ELSE
                    IF  ERR <> 13%  THEN  ON ERROR GO TO 0
                            ELSE
                            F% = 1%
                            \ RESUME 260
600         CLOSE 1%, 2%
            \ PRINT 'PROCESSING COMPLETED; ' + F$ + ' COMPLETE.'
32767       END
```

B. To initiate program.

1. Assemble all necessary equipment according to the diagram below, including (a) Digicassette, (b) Interface, (c) Acoustic coupler, (d) Telephone, (e) Teletype or video monitor, (f) Cassette tape.



2. Computer interaction procedures

	Computer will print	On Keyboard type:	Comments
1.	#	Hello	
2.	#	220, 200	account number
3.	Password?	French	secret, does not print
4.	Welcome to RSTS/E V06C time sharing		
5.	Ready	Run Pack 25; Fixup	
6.	File?	Pack 25: (name on file)	
7.	Side at which to begin text transmission?	1	can be 2 or 3 depending on where you ended transmission
8.	Press (return) to begin		only do this after you have prepared Digicassette

3. Preparing Digicassette

   a. Put cassette tape into Digicassette

   b. Push in Record button

4. Now press (Return) on the teletype.

   500 ***'s will appear

   Cassette side 1,,(name on file),,

   (the text will print now)

   End of cassette side 1 ??????????????

   (machine beeps until cassette is turned over)

5. To record side two of the cassette

   a. turn over cassette

   b. press (return) on the teletype

   c. 500 ***'s will appear

      cassette side 2 ,, (name of file),,

      (the text will print now)

   When the last side of the text has been printed,

   instead of "end of cassette side ?????" will appear.

   (Machine beeps until cassette is removed.)

6. To shut down system

   a. Press (return)

   b. Type: BYEF

   c. Computer will type: Ready

   d. Turn power off.

Appendix 14

Paper submitted to Journal of Visual Impairment and Blindness, based on conference call

Discussion: Experiences with ELINFA's Digicassette in Research, Educational, and Employment Settings

Edited by

S. C. Ashcroft

and

M. Bourgeois

Department of Special Education
George Peabody College
of Vanderbilt University
Nashville, TN 37203
January, 1980

This document was prepared pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express their judgment freely in professional and technical matters. Points of view or opinions do not, therefore, necessarily represent official Office of Education position or policy.

"The evaluation and research program for the Portable Braille Recorder (Digicassette)" funded by BEH was designed to determine user satisfaction and the practicality, reliability and maintainability of the Digicassette and to study the braille reading and writing abilities of Digicassette users. Thirteen Digicassettes were placed in educational settings in Columbus, Ohio and Nashville, Tennessee to serve elementary and secondary school braille reading students in local day and residential school programs. Braille reading college students also participated in this study. A program of formative and summative evaluation was designed for the continuous assessment and the final appraisal of the Digicassette to include data collected from Digicassette users, teachers, project personnel, and others.

On October 24, 1979 S. C. Ashcroft, principal investigator of the project held a telephone conference with a group of individuals in order to discuss their experiences with ELINFA's Digicassette. Included in the conference call were:

Lawrence Scadden
Smith-Kettlewell Institute of Visual Sciences
San Francisco, California

Bill Kalenius
Clover Park School District
Tacoma, Washington

John Taylor
Iowa Commission for the Blind

Norma Krajczar
New Jersey Commission for the Blind

Tim Cranmer
Kentucky Commission for the Blind

Fred Sinclair
Clearinghouse Depository for Handicapped Students
Sacramento, California

Susan Spungin
American Foundation for the Blind

S. C. Ashcroft
Professor of Special Education
George Peabody College
Nashville, TN.

Michelle Bourgeois
Research Assistant
George Peabody College
Nashville, TN.

The purpose of the conference call was to share positive experiences about and to relate problems encountered with the Digicassette. An additional objective was to discuss the future use of the Digicassette in educational and employment settings.

Following introductions and a review of the purpose of the telephone conference call, Michelle Bourgeois, Research Assistant, began the discussion with a synopsis of the Digicassette evaluation research completed in Ohio and Tennessee during the past two years using thirteen 12-cell Digicassette machines. (Manuscripts in preparation describe this project and the results of the studies in greater detail than the following synopsis.)

Michelle Bourgeois: In brief, we have evaluated the oral reading rates and writing rates of 8 blind students in Ohio and 16 blind students in Tennessee. Five of these students were in grades three through seven, 13 students were in grades nine through twelve, and the remaining 6 students were undergraduate and graduate students at George Peabody College. Using the appropriate grade-level reading materials, brailled on cassettes for the Digicassette, we found that all students, regardless of

age, read with the Digicassette at 50% of their reading rate with conventional braille materials. Writing rates using the Digicassette were virtually identical to writing rates using the Perkins brailler for all students.

Question: How much training did students receive?

Michelle Bourgeois: The high school and elementary school children received four hours (four hour sessions) of intensive training and practice with the Digicassette. During this time, I taught the students all the various components and functions of the machine, questioned them about the machine, answered their questions, and let them practice reading and writing with the Digicassette. After the four training sessions, a criterion-referenced proficiency test was administered to each student to insure that they could reliably and independently operate the Digicassette. A score of 95% or better was required on this test before oral reading rates could be established using the Digicassette.

Question: How was oral reading rate tested?

Michelle Bourgeois: On any one day of testing, each student read aloud passages brailled on cassettes with the Digicassette and passages in paper braille. The passages and the reading condition were counterbalanced throughout the testing period. The study

was conducted over a 6 month period. I tested students' oral reading rates approximately once a week.

Question: Prior to measuring the reading rate with the Digicassette, how much time did students spend reading materials with the Digicassette?

Michelle Bourgeois: Not as much as we would have liked. We had several computer-generated braille cassettes of fiction materials which they could read; however, most students used the machines for note-taking in their classes, and they limited themselves to reading back their notes. We do not have any reliable way of determining how much actual time was spent reading with the Digicassette outside of the instructional and testing sessions.

Question: Is the 50% reading rate an average of all the scores during the study for any one person or is it the final score?

Michelle Bourgeois: The 50% reading rate is an approximation of the average reading rate scores during the study. However, it must be noted that only two students demonstrated significant improvements in reading rates across time. Generally, reading scores would increase during the first month of testing but would level off after that.

Question: Based on the final reading rate scores, did any student come close to 90% of their oral reading rate with paper braille?

Michelle Bourgeois: No. Our best braille reader and most enthusiastic Digicassette reader averaged 250 wpm with paper braille and was reading 125-140 wpm with the Digicassette after 6 months of continual usage.

L. Scadden: Obviously, as students acquire more experience with the machine, their oral reading rates will increase. The 50% rate is quite understandable and not bad at all.

Question: In considering some of the variables which might have detrimentally affected oral reading rate, would you think that the indexing feature and the inability to backtrack more than 120 characters at a time were significant factors?

Michelle Bourgeois: We surmise that machine related variables such as the sensitivity of the touch control switch, the 12-character line, the lack of hyphens, and the lack of a line-by-line backtracking feature were directly related to the oral reading rate scores. We taught the students how to use the Digicassette's indexing system, a tape counter device; however, during test sessions students were not required to search specific locations on the tape. Also, during testing situations students did not reread a block of 120 characters as often as they appeared to during instructional or practice sessions. This can be accounted for by the fact that oral reading, not comprehension, was being tested.

Question: How well did the machines operate during the study?

Michelle Bourgeois: Surprisingly well. During the first year of the study in Ohio, there were numerous machine malfunctions which required factory repairs. However, this year I developed a troubleshooting unit within the instructional program in order to teach the students how to handle machine malfunctions. This proved to be instrumental in keeping equipment breakdown to a minimum. In six months only two the the 13 machines were returned for factory repairs.

Question: Were your students asked for their subjective evaluation of the Digicassette?

Michelle Bourgeois: Yes, I administered several questionnaires at the end of the study. In general, the college students liked the Digicassette because of its time saving features for note-taking in classes. However, they were reluctant to continue using the machine because of its high cost and the fact that once their notes were brailled on cassettes they would need to have a Digicassette to read them with in the future. The high school-aged students could not see the advantages of the Digicassette to them during high school, but remarked they would like to use one in college.

Susan Spungin, Education Consultant for the American Foundation for the Blind, participated as a consultant to the "Evaluation and Research Program for the Digicassette".

S. Spungin: I am concerned about the ethical or moral considerations in using elementary school children as subjects in an evaluation project of this nature; particularly if using the Digicassette would slow down their reading rate with paper braille. I would like to suggest that studies with this type of equipment be done with older children.

Michelle Bourgeois: Although six elementary school children participated in this study, they were given instruction in how to use the equipment and were tested minimally. In fact, only one student, a seventh grader, participated in data collection activities longer than 1 month. We have not yet done a follow-up study to test whether or not the older children have decreased their reading rates with paper braille as a result of their exposure to the Digicassette. My hypothesis is that their paper braille reading rates would not have been affected.

S. Ashcroft: I would contend that reading with the Digicassette will facilitate and enhance regular braille reading. The experience of coping with the 12-cell display and the unique division of words at the end of lines will make children even more capable braille readers rather than inhibit them.

Lawrence Scadden, of the Smith-Kettlewell Institute of Visual Sciences-has a 12-cell Digicassette which he uses in his research and for his own personal use.

L. Scadden: I have found, with a limited amount of work that we have done, that reading rates as high as 70% have been achieved; however, these are results of an informal study with a limited population. This study was conducted in a similar manner to Michelle Bourgeois' study. The fact that you cannot go back one line at a time and reread lines makes reading difficult; and I consider this a factor in slowing down the reading. I have not used the 20-cell machine long enough to be able to say whether or not the extra cells would increase reading rate.

We have found that interfacing the Digicassette with the TRS-80 Micro-Computer does work. However, you need a full time engineer and technical assistance from ELINFA Company to render the system operational. One problem we have encountered using the Digicassette with the computer is that it is difficult to keep track of where you are in a particular line. The computer output format (80 characters per line) is difficult to follow using the 12-cell display.

Tim Cranmer, of the Kentucky Commission and the Blind, utilizes a 12-cell Digicassette and computer interface in his work.

T. Cranmer: We use the Digicassette interfaced with a HP-9825A computer mainly for storing reading materials such as cookbooks and sewing machine manuals. The Digicassette has been used by myself and other blind people in the agency without any formalized attempts to evaluate the machine. Subjectively, I would prefer major modifications in the braille display and in the handling of materials on the tape before I could find it completely acceptable. Also, I find that as a programming tool, the Digicassette is weak because of the necessity to access information in a serial fashion on the 12-cell display.

John Taylor, of the Iowa Commission for the Blind, has one 12-cell Digicassette and a computer interface.

John Taylor: Our principal use of the Digicassette is as a computer terminal. Once we overcame some problems with the interface, we were able to access the Honeywell computer at Drake University, quite successfully. The major problem with the interface was a voltage difference between the interface and the computer that caused problems when we tried to input information from the Digicassette. We have also used this system with a remote telephone modem.

ELINFA's service left a good bit to be desired in terms of honoring commitments they had promised.

The Interface mechanism took longer to get than we were told. When we needed service, the waiting period was extensive. Recently, however, they have improved their services.

Our interest in the Digicassette is much more as a computer terminal than as a note-taking device, as using it for note-taking seems to be a fairly expensive way to go.

Norma Krajczar of the New Jersey Commission for the Blind replaced Victor Pollara of that agency during this Conference Call. Victor Pollara uses a 12-cell Digicassette in his work.

N. Krajczar: We have a 12-cell Digicassette and are still waiting for a 20-cell model. We have had no experience with it as a computer terminal; actually our experience with it is very limited because of the frustration encountered with it. We are looking forward to getting the new model with its improved features.

Bill Kalenius of the Clover Park School District in Tacoma, Washington utilizes several 12-cell Digicassettes in vocational and academic applications.

B. Kalenius: Basically, we are interested in using Digicassettes with elementary, junior and senior high students, however, we have not replaced any paper braille with the cassette braille because of our experience. We encountered problems obtaining first the equipment and then the software. The mechanical attributes of the 12-cell model are very difficult for younger students to handle.

We have successfully interfaced the Digicassette with our word processor. We feel that students trained in word processing would have a valuable and marketable skill. The young blind employee would then have access to the mountain of paper that is being stored in word processors.

F. Sinclair: I have had limited experience with both the 12-cell and the 20-cell Digicassette. I am concerned about whole word understanding when using the Digicassette that does not use syllabication rules and hyphens when outputting information onto the display. The Versabraille equipment by Telesensory may have solved this problem.

I have submitted a proposal to acquire a limited number of the Digicassette and Versabraille machines to place with volunteer braillists. The goal of the project is to develop guidelines for preparing braille materials on cassettes. In particular, we will be interested in adapting the existing braille textbook format and the scientific, nemeth and music codes for transcription on braille cassettes.

S. Ashcroft: M. Bourgeois and I are presently preparing the final report on the "Evaluation and Research Program for The Portable Braille Recorder (Digicassette)," that will be available as of January 1, 1980. We are funded again by the Division of Media Services of BEH for the next two years to look at curricular

and prevocational applications of paperless braille recorders and micro computers. We look forward to using the Versabraille equipment and the 20-cell Digicassette. We have the Radio Shack TRS-80 micro computer and have interfaced it with the 12-cell Digicassette.

We would welcome any information available about using Digicassettes, Versabraillers, and computers with blind youth; particularly if blind youth are using computers in academic and vocational settings. Naturally, we will be most happy to share our findings.

Appendix 15

Association for the Education of the Visually Handicapped Presentation Paper

EVALUATION RESEARCH REPORT:

THE DIGICASSETTE BRAILLE RECORDER

M. Bourgeois, Research Associate

George Peabody College for Teachers
of Vanderbilt University
Nashville, Tennessee

Paper presented at
The Association for the Education
of the Visually Handicapped
Nashville, Tennessee
June 16, 1979

Electronic and computer technology is beginning to make a larger and more pervasive impact on the education of visually impaired children than ever before. Instruments such as the Optacon, the Kurzweil Reading Machine, and paperless braille equipment should have a far-reaching and profound effect on these children. As educators, however, we have a duty and responsibility to these and future blind children to insure that the quality, practicality and reliability of new equipment that becomes available is not merely adequate, but that these devices will have a positive and beneficial effect on the educational performance of these children.

Fortunately, federal funding agencies are aware of the need to carefully evaluate new technological developments. This is a report on one such evaluation project funded by BEH, Division of Media Services; entitled "Evaluation and Research Program for the Portable Braille Recorder (or Digi-cassette)." While purposes of this project include 1) field testing the Digi-cassette in order to establish its potential as an educational aid for blind children, 2) determining user satisfaction, practicality, reliability, and maintainability of the Digi-cassette, and 3) studying braille

reading and writing performance with the Digi-cassette, this paper discusses the preliminary data collected on reading performance with the Digi-cassette.

The Digi-cassette is an electronic braille reading and writing machine, that uses audio cassettes instead of paper to store information.

(figure 1)

The user can prepare a text using the standard braille keyboard and later read it back on this 12-cell or a 20-cell display. When reading a text, the user simply turns on the machine and presses the transfer button to advance the tape. When information in braille appears, the first 12 cells of the text pop up out of the display. The user can then read them and when finished, simply touch the touch switch to read the next 12 cells. In this manner, the user can control the rate at which he reads the braille cells. Theoretically, this machine has the potential of alleviating the imbalance in supply and demand for conventional braille volumes, to say nothing of the cost reduction and space-saving features of audio cassettes as opposed to braille books.

However, several of the Digi-cassette's unique features warrant investigation. The most obviously different features of this equipment are the 12-cell braille reading line, and the touch switch. These two factors often require major changes in braille readers' reading habits. For example, while it is not unusual for the blind child to use the three middle fingers of both hands to read a braille volume, the

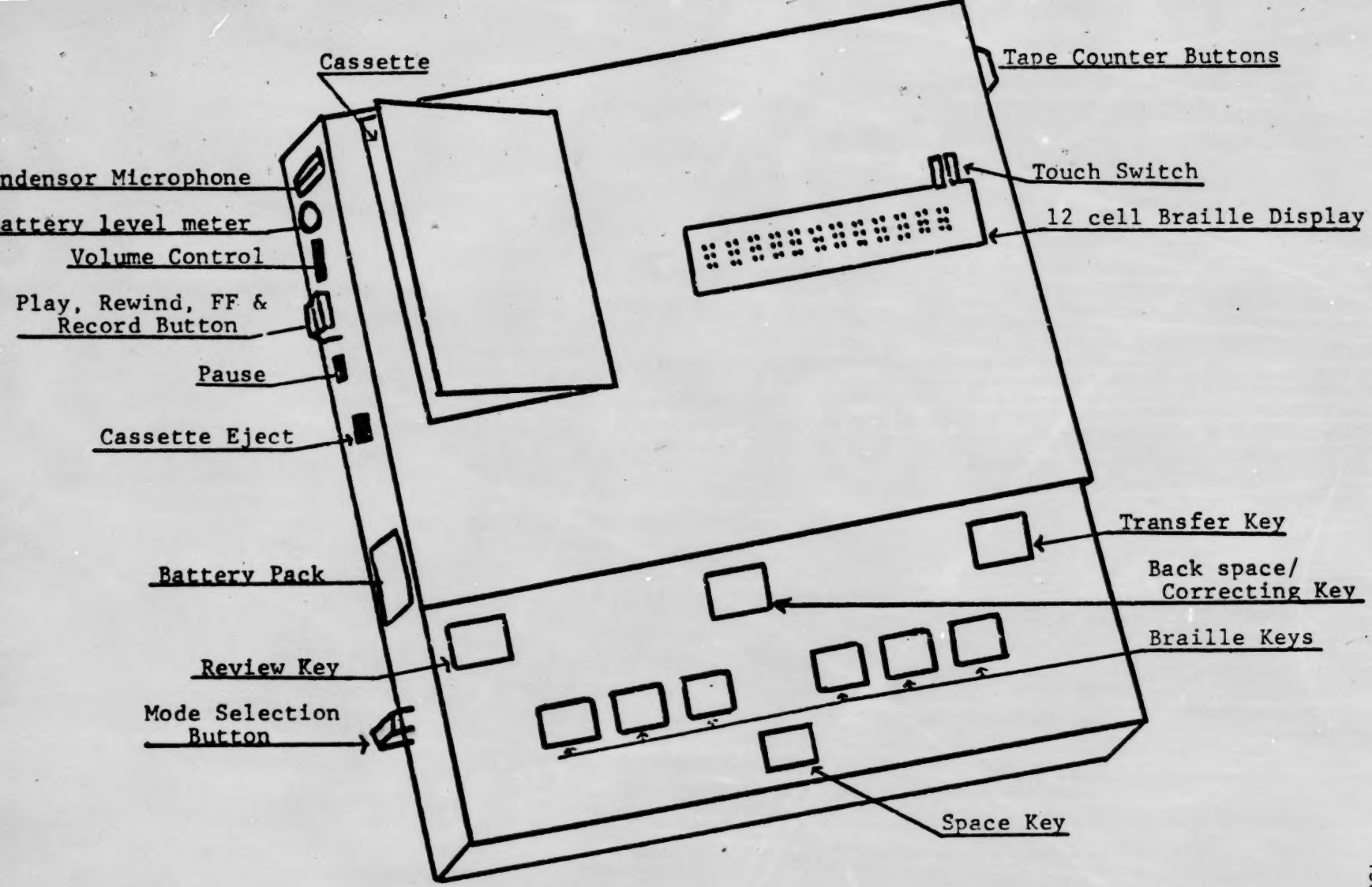


Figure 1. Digi-cassette Schematic

the same child has to limit himself to one, or at best, two index fingers when reading the Digi-cassette. This in part, is due to the sensitive nature of the touch switch, which is a simple circuit requiring only the slightest touch of a finger to be completed and to change the line of braille.

The 12-cell display can also cause problems for the reader. For example, when a word does not fit in entirety within the 12 cells, the word is broken indiscriminately at the letter filling the 12th braille cell, and the remainder of the word's letters appear on the next line. No hyphens appear when this occurs. As a result, the probability of reading errors increases. An isolated "s" symbol in the 12th cell is easily read as so, whereas it could just as likely be the first letter of the word "sailor."

Therefore, it is of interest to know how well students can read braille using the Digi-cassette when they are required to adapt to a 12-cell reading line and to a sensitive touch switch. It is also of interest to discover whether or not the students' reading errors will increase as a result of using the Digi-cassette. The purpose of the following study was to establish oral reading rates and oral reading error rates for subjects reading conventional braille volumes and brailled materials with the Digi-cassette. Statistical treatment and graphical representation of the data will demonstrate trends in student performance. Comparisons of reading rate and reading error rate performance in two reading modes (conventional braille vs. braille on Digi-cassette) will be made.

Method

Subjects

Presently Digi-cassettes have been placed with three blind elementary school children in local day schools, six high school students from the residential school for the blind, and four blind college students at George Peabody College. These participants were chosen on the basis of their desire to learn to use this equipment for note-taking in their classes; all participants were braille readers. Each elementary and high school aged participant received an average of four hours of orientation and instruction with a staff member, after which a criterion-referenced proficiency test was administered. A score of 90% or better on this test insured that the child had mastered the operations of the Digi-cassette.

College students required no more than one hour of orientation and instruction to become proficient in operating the Digi-cassette.

Procedures

Data collection activities proceeded in the following manner. During four 1 hour sessions in which subjects were instructed in the operations of the Digi-cassette, five minute audio-recordings were made of the subjects reading from novel junior/senior high school level reading materials in braille. A word per minute score for each session was calculated for each subject by taking the mean of the five 1-minutes samples.

A criterion referenced proficiency test was administered to each subject during the fourth session. A score of 90% or better insured that the subject could operate the Digi-cassette and could successfully troubleshoot equipment malfunctions.

After obtaining a 90% score or better score on the criterion-referenced test, oral reading rates were established using the Digi-cassette and pre-recorded braille cassettes during weekly assessment sessions. The mean of five 1-minute timed intervals was calculated for a word per minute score. Oral reading was tape recorded and later transcribed in order to establish reading rates and reading error rates. Reading error rates for each subject were calculated from the reading samples. A reading error was defined as any incorrect repetion, self-correction, incorrect word, or unread continuous portions of the text. The reading materials used were novel junior high graded reading passages, such as Island of the Blue Dolphin and Little Women.

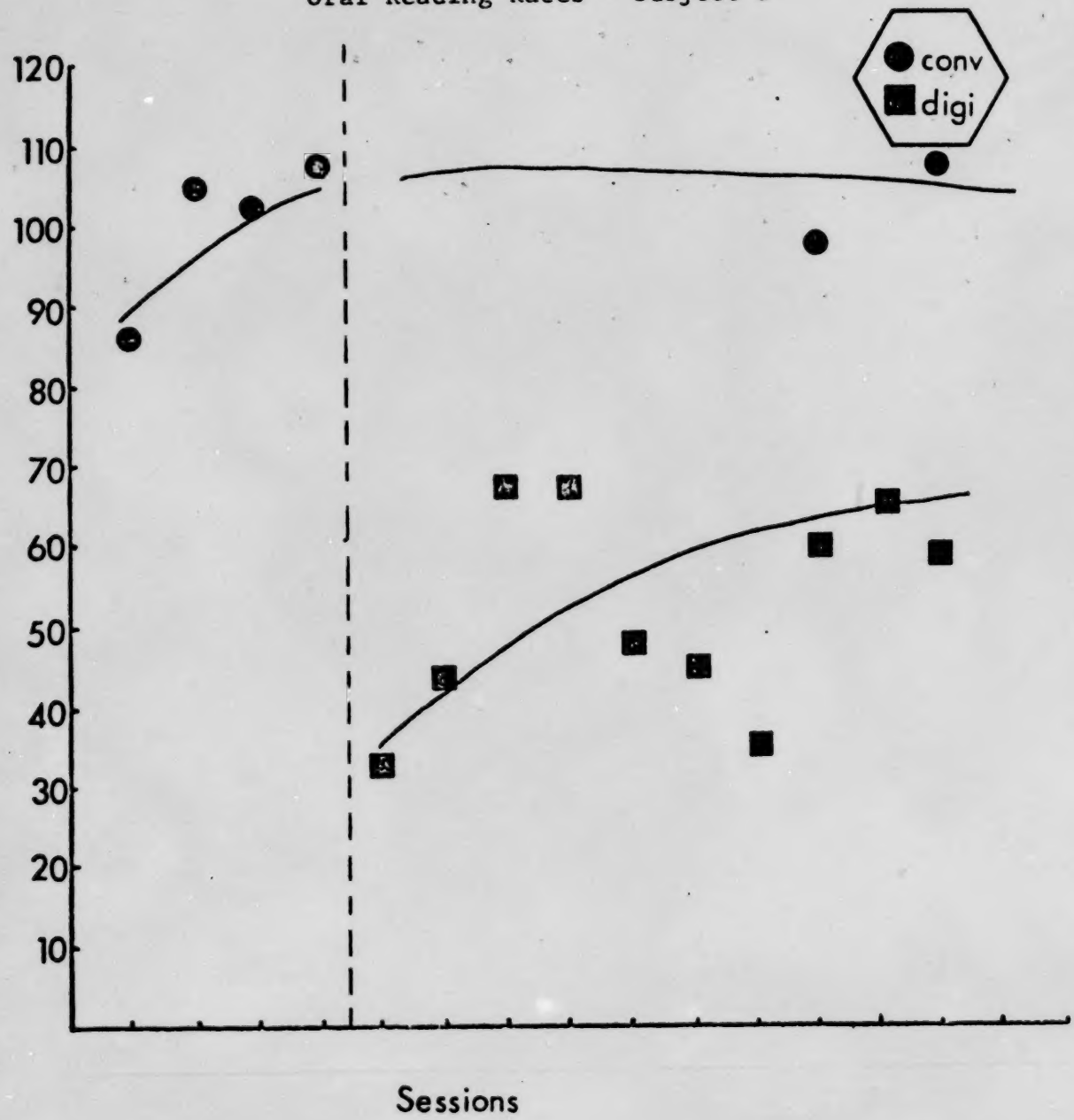
Subjects contracted with the staff for the length of time they served as participants. After their contracts had expired, each student was asked to answer detailed questionnaires about the Digi-cassette's functions and their own satisfaction with it.

(figure 2)

Results

Figure 2 is a graph of subject 1's reading performance with conventional braille books (conv. - circles) and with

Figure 2
Oral Reading Rates - Subject 1

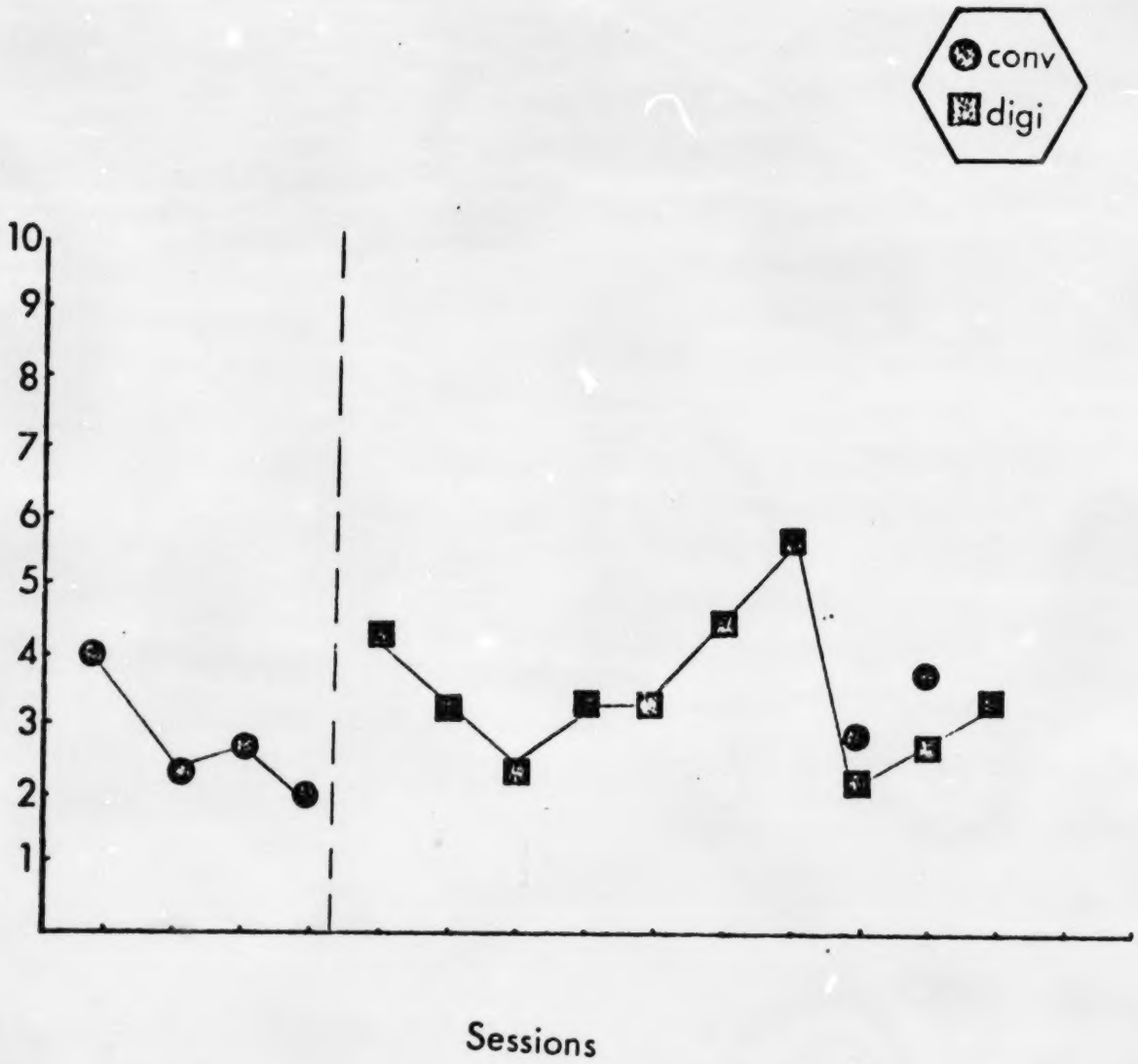


Digi-cassette braille tapes (digi- squares). The first four data points represent the number of words per minute read with conventional braille during the instructional (or baseline) period. The dashed line represents administration of the criterion-referenced proficiency test. Squares represent word per minute scores for oral reading with the Digi-cassette. Notice that subject 1's oral reading rate with the Digi-cassette (approximately 60 wpm) is consistently slower than his reading rate with conventional braille (approximately 105 wpm). The positive trend in the Digi-cassette reading rate scores would lead one to predict insignificant differences between reading rates in the two reading modes in time.

Figure 3 represents the reading error rate for the two reading modes. Again, circles represent the mean of five 1-minute conventional braille reading samples and the squares represent Digi-cassette reading samples. Notice the similarity in reading error rates between the two modes: with conventional braille the range of errors per minute is 2 to 4 and with Digi-cassette braille the range is 2 to 5.5 errors per minute.

Because the six high school subjects demonstrated results similar to those of subject 1, the data for these seven subjects were grouped. Figure 4 represents the preliminary grouped data for oral reading rates. As shown in Figure 2, reading rates with conventional braille are consistently

Figure 3
Oral Reading Error Rates - Subject 1



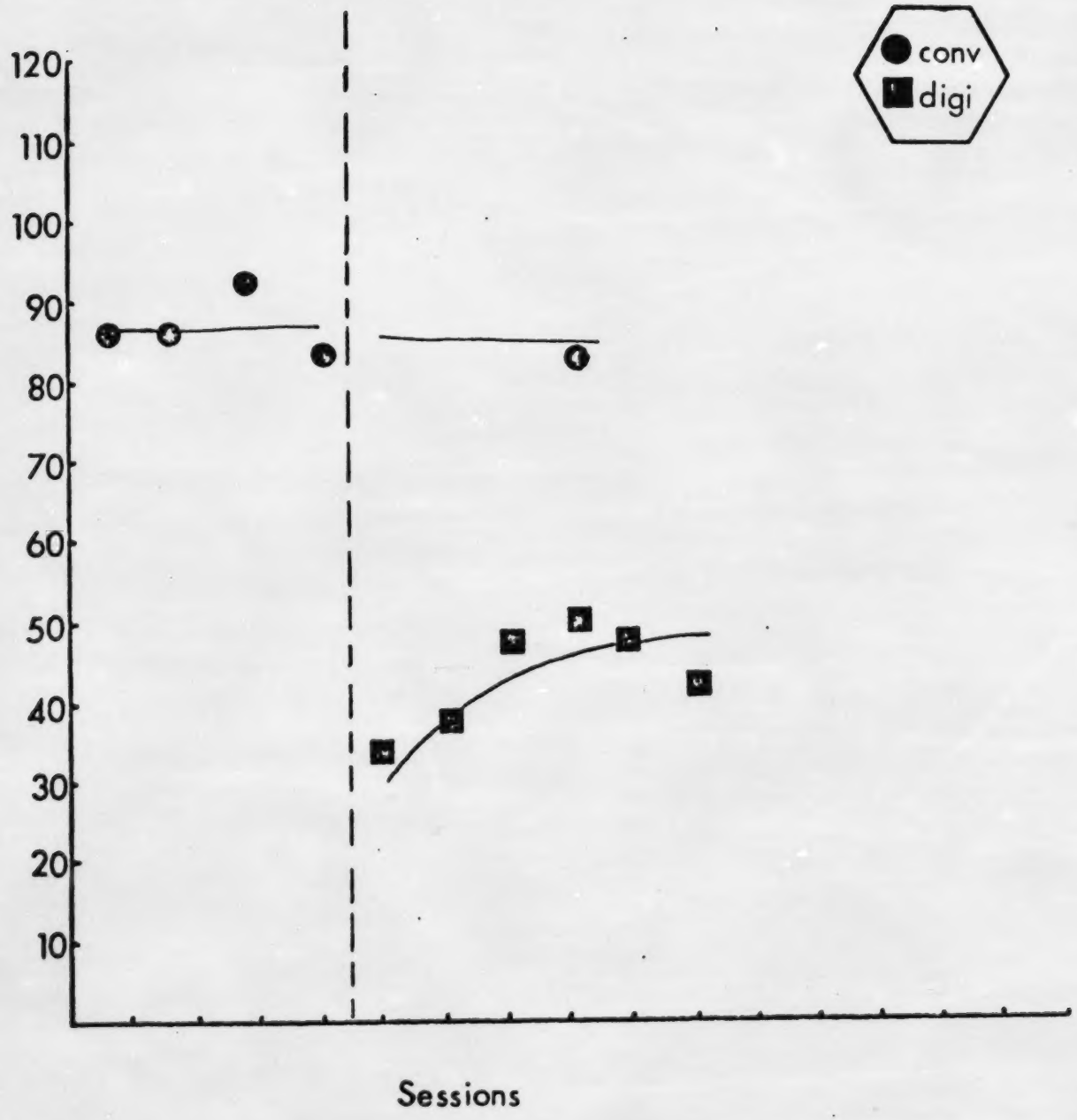


Figure 4
Oral REading Rates: Group Data, N=7

faster (approximately 90 wpm) than reading rates with the Digi-cassette (approximately 50 wpm). The oral reading performance with the Digi-cassette, as shown in Figure 4, demonstrates a positive trend. However, the considerable difference in performance between conventional braille reading and braille reading with the Digi-cassette suggests the need for improving braille reading with the Digi-cassette.

Figure 5 represents the oral reading error rate grouped data for the two reading modes. Again, notice the similarity in error rate performance between the two reading modes. The range in error rate for conventional reading is 1.8 - 2.4 errors per minute, while the range for reading with the Digi-cassette is 1.8 - 2.9 errors per minute. Although statistical tests have not yet been run, significant differences are not anticipated to be established.

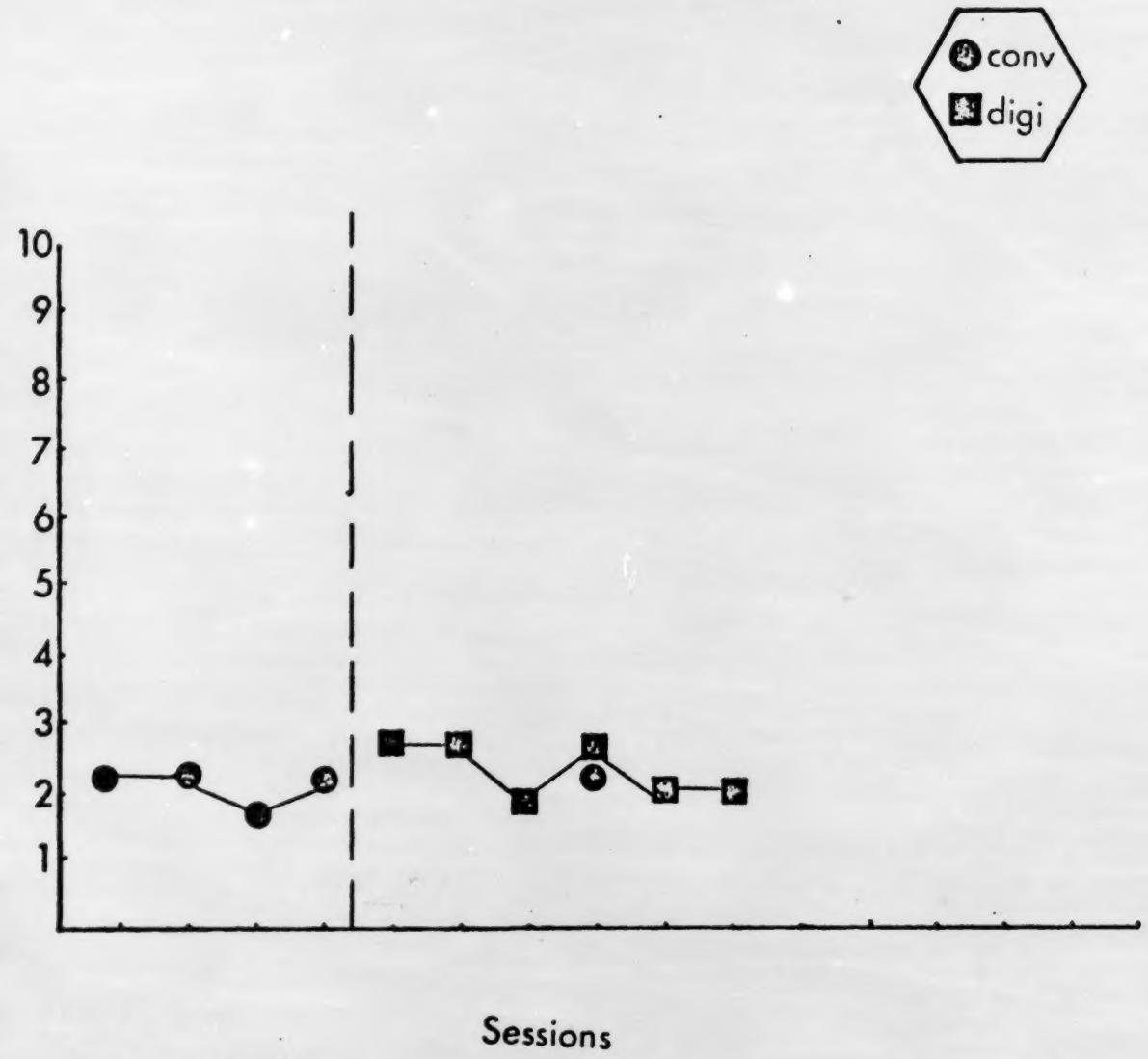
Discussion

These data suggest several points:

1. Reading with the Digi-cassette is slower than reading conventional braille. Subjects consistently read 30-50 wpm slower when reading with the Digi-cassette.

2. The similarity in reading error rates between the two reading modes suggests that the mechanical features of the Digi-cassette and the problem of "broken" words at the end of a line, are not causing significant numbers of errors to occur. Because of the nature of the Digi-cassette, subjects may be slowing down their reading rate, as demonstrated by their reading rate performance, in order to compensate for the

Figure 5
Oral Reading Error Rates: Grouped Data, N=7



adjustments made in their reading style due to the Digi-cassette. As a result of their slower reading rate, subjects may be committing fewer actual reading errors, yet enough machine handling error for the total number of errors to be similar to the errors committed when reading conventional braille. Reading transcripts need to be examined further to categorize the actual types of errors committed in reading.

3. Low oral reading rates with the Digi-cassette may be accounted for 1) by lack of experience with the Digi-cassette (3 months for Digi-cassette vs. 8-10 years for conventional braille), 2) by modification in personal reading style (from coordinated two handed reading to one handed reading) or 3) by increased memory load for past words or letters due to the nature of the 12-cell braille line. Further research is needed to test these hypotheses.

This study was designed to establish the differences in oral reading rates between the two reading modes when subjects received only informal instruction in reading the 12-cell display. Perhaps a reading program could be developed which would improve reading rate scores for a 12-cell braille line.

In conclusion, the data reported today are only preliminary data. Further compilation of data and statistical treatment of the data are necessary before a definitive statement of the results can be suggested. It is hoped that other researchers and educators will use this research model to collect performance data for students using equipment such as the Digi-cassette, Versabraille, Optacon and others.

These data will then be useful in the modification of equipment and in the design of educational programs which will be bnenfical to visually impaired students.

Appendix 16

Special Education Technology Presentation Paper

RECENT TECHNOLOGICAL DEVELOPMENTS FOR THE VISUALLY IMPAIRED: STATE OF THE ART

by

S. C. Ashcroft

and

M. S. Bourgeois

George Peabody College of

Vanderbilt University

During the early 1960's, the American Foundation for the Blind conducted an international survey of technical devices available to visually impaired persons. These efforts resulted in the convening of an international congress of scientists, whose task it was to present then recent technological developments, to evaluate those devices, and to propose avenues of future research in the area of aids and appliances for the visually impaired (Clark, 1963). It was prior to 1963 and the International Congress on Technology and Blindness that innovations such as the tape talking book, high speed braille embossing, teaching machines, and electronic travel aids had begun to make an impact on the education of blind children and youth. A virtual technological revolution has followed. Currently, unique applications of laser beam science, computer speech synthesis, and micro-chip electronics to the everyday problems of persons who are blind now have the potential to open many educational opportunities and employment possibilities.

Since 1963, psychologists, electrical engineers, educators, and persons from other disciplines have exchanged information and ideas enabling a wide variety of new technological devices to appear on the market. Private research and development firms, frequently associated with behavioral science and other laboratories at major universities, have undertaken the development of equipment to meet the various needs of visually impaired individuals in the business world and in educational settings.

Applications of technology to the improvement of the lives of persons with severe visual impairment are directed at mitigating three major problems. These problems are (1) the optimum use of remaining sensory channels, (2) mobility, and (3) access to the printed word in graphic forms (Dupress, 1963).

Recent developments in technology create the most promising possibilities ever yet available for solving or ameliorating these problems. The purpose of this paper is to describe some of the current developments, illustrating the role technology can play in the education of visually impaired persons and to propose the systematic evaluation of presently marketed devices.

Using Remaining Sensory Channels for Access to Printed Material

The Auditory Sense

Visually impaired individuals rely on auditory and tactile senses to provide the information sighted people receive through the visual sense. It is not surprising that researchers have long been interested in developing devices to exploit these two remaining sensory channels. Through the production and widespread distribution of "talking books" (audio recordings in record or cassette form), the development of compressed speech equipment which allows the person to listen to recordings at rapid speeds and normal pitch, and the availability of sighted readers, visually impaired persons utilize their auditory sense for the reception of printed materials. Perhaps the most dramatic and widely publicized current application of technology utilizing the auditory channel is the Kurzweil Reading Machine (KRM). The KRM produces synthesized speech from the optical scanning of the printed page, translating graphic symbols into speech sounds. The Bureau of Education for the Handicapped, the Veterans Administration, and the Rehabilitation Services Administration, along with foundation support, have enabled the rapid development of a desk top version of this reading machine. Introduced in 1975, the KRM, said to be fully human engineered and field tested, reads a wide range of type faces by means of a naturalistic speech synthesized "voice." To use

this machine, a person simply places a book or printed page face down on the machine. By manipulating a small terminal, the person controls the tracking device that finds the top of the page and begins to read aloud. Any word which does not conform to the programmed rules of pronunciation or to the exceptions to those rules is spelled out letter-by-letter. The advantages of this machine are obvious. Since not all books and reading materials are available in braille to visually impaired individuals, this machine will provide a great service to those who have access to it. Students will no longer have to wait for materials to be brailled or to obtain the services of a sighted reader in order to read. Teachers will be able to encourage and foster independent study habits through access to this machine. Although the print-to-speech process may be a momumental development in and of itself, the Kurzweil Computer Company is continuing to break ground in this area. The KRM will soon include the capability of automatically translating printed material into high quality, full-page, Grade 2 braille for those individuals who prefer to read some materials in braille. A special interface will enable the KRM to convert printed text from a computer terminal or a cathode ray terminal into speech. Another output interface will enable temporary braille displays and other output devices to be used in parallel with the speech output.

Some of the problems encountered by visually impaired persons attempting to solve mathematical problems have been reduced by talking calculators. The Speech Plus Talking Calculator, developed by Telesensory Systems, Inc., is a hand-held calculator specifically designed for users who are visually impaired.

It has a twenty-four word synthesized vocabulary which announces each entry and result. Its "speak" key enables one to hear the display contents without performing additional operations. Visually impaired children and adults are benefitting from using this calculator for solving math problems in school and for managing business enterprises and personal finances.

By linking the synthesized speech technology used in talking calculators to a micro-computer, a new world of employment opportunities has been opened up for the visually impaired individual. The simple replacement of one cassette-sized computer program with another enables a secretary who is blind to have an in-house telephone directory, an automatic form writer, or the company's data management system at his/her fingertips. Another cassette program provides a transcription of print to braille; yet another offers the manuscript editing features of a word processor. Maryland Computer Services of Bel Air, Md. has been instrumental in producing micro-computer systems with speech outputs and the related software programs necessary for visually impaired employees to meet the needs of their employers. For example, the names, addresses and telephone numbers of as many as 6,000 persons can be stored in the computer and accessed by the blind operator utilizing the Talking Telephone Directory program. The operator needs only basic typing skills to interact with the Directory that responds visually and vocally with the requested information (telephone number, credit limit, room number, etc.). Standard features allow the operator to handle duplicate names and daily updates. A blind operator at the University of Kentucky handled 85 calls an hour as compared to 50 to 55 calls an hour for her sighted counterparts using

traditional methods of retrieval. Retrieval time from name input to number output is six seconds with the tape version and one second with the disc drive unit.

The Tactile Sense

In the education of youth who are visually impaired, teachers have depended extensively on their students' tactile sense to receive information in the form of braille, the well-known raised dot alphanumeric code. Traditionally, highly skilled braille transcribers have been required to convert printed materials into braille. This time-consuming process has become modernized through the introduction of computer technology; however, the range and extent of availabe materials is less than optimum due to the time factor involved in any print-to-braille or typewriter-to-computer conversion process. Telesensory Systems, Inc. of Palo Alto, California has developed a device which would enable a person who is blind to read by touch directly from the printed page, eliminating the need for braille materials. This machine, the Optacon, or Optical-to-Tactile Converter, converts print into a vibrating tactile form of the letters and consists of a miniature hand-held zoom-lens camera connected to a series of 144 vibrating pins. When the camera is passed over a line of print or another image, the image it collects is directly translated into a tactile representation through the array of vibrating pins. By placing a finger on the Optacon's tactile display screen, the user reads while moving a miniature camera across a line of print with the other hand. Because the Optacon reproduces any type style or language, it can be used for reading any type of printed material encountered in daily life, including bank statements, telephone directory numbers, recipes, and can labels.

Thousands of students, from the primary grades through college, now have tactile access to the world of print through the Optacon.

The Optacon has probably done more to open vocational opportunities for persons who are blind than any other device in recent memory. For example, a major airline has employed its first totally blind airline reservationist. Using a specially adapted camera to read the computer terminal, this operator could easily process more than 80 calls per day. The Optacon is used by blind persons of all ages, including totally blind radio operators, telephone operators, secretaries, and students, in numerous educational, vocational, and recreational capacities. The addition of a spoken word output to the Optacon will provide a counterpart to the KRM and will enable blind users to learn to associate the vibrating representation of the print letter more rapidly than in the past.

For those individuals who may have a difficult time learning to read the vibrating print letters produced by the Optacon, and for whom braille is the most desirable reading medium, technologists in Europe and the U. S. have developed electronic braille reading and writing machines. Since these devices allow users to record and store braille information on magnetic tape cassettes used in ordinary audio tape recorders, they are often referred to as "paperless" braille recorders. ELINFA, Inc., a French electronics firm, has developed the Digi-cassette machine that encodes braille onto audio tape cassettes and provides a braille readout in a twelve or twenty-cell recurring display. The Digi-cassette serves a dual purpose for visually impaired students: not only can they read and write braille with it, but they can also record and playback sound recordings. Using a conventional braille keyboard, the Digi-cassette records coded electronic information on the audio tape, the infor-

mation is then displayed by an electromechanical reading board. Metal pins represent the dots of braille cell to allow the reader accesss to the braille characters. Because more than 150,000 braille characters can be recorded on one side of a 90-minute cassette tape, the bulk of volumes of conventional braille books has the potential of being drastically reduced. The storage space required for standard braille material in book form can also be reduced dramatically. As an example, the novel ROOTS, by Haley, which is comprised of 800 pages in print and would require seven braille volumes about 11 x 13 x 2 inches each, can be stored on just over four ordinary audio tape cassettes. The same book in recorded form requires twenty-four hours of recording on fourteen discs or five audio cassettes at 15/16 inches per second.

The development of the Digi-cassette interface, a device which converts braille characters into a stream of serial computer-language characters, has resulted in versatile machine which can serve as a computer terminal. By connecting the Digi-cassette interface, and other equipment, such as typewriters, telex machines, and computer modems, to the Digi-cassette, a blind user is able to perform many of the same functions as his sighted peers.

For instance, the Digi-cassette can be interfaced with an IBM type-writer, enabling a blind secretary to proof-read his/her own typing in braille. Conversely, the secretary who is blind is also able to type a text in braille on the keyboard of the Digi-cassette. This text will be typed at the same time in ordinary print characters on the sheet of paper

put in the typewriter, or a text can be typed automatically from a tape previously recorded in braille. Any sighted typist without knowledge of braille can type a text on this typewriter, recording it simultaneously in braille on the Digi-cassette for future use by the blind employee.

The Digi-cassette can also be used with many models of electronic calculators. The calculator can be controlled either by its own keyboard or by the braille keyboard of the Digi-cassette. In the latter case, the orders given to the calculator can be read immediately on the braille display. The results of the calculations are displayed in braille on the Digi-cassette and on the visual display of the calculator at the same time. This convenient arrangement enables teachers to teach mathematics to their students who are blind in an efficient and timely manner, and enables blind businessmen and college students to interact with their sighted peers.

The Digi-cassette can be used effectively as a portable braille computer terminal which gives the person who is blind a highly effective way to work with computers. A computer programmer could, for example, write his program onto the Digi-cassette, read it back, make corrections at will, transfer the brailled information directly to the computer, and then wait for the computer's response. The Digi-cassette interface is directly connectable to standard modems, allowing the performance of all of these operations over long distances by means of telephone lines or specialized networks. Telex messages, also can be received and recorded directly in braille on a cassette.

Telesensory Systems, Inc. has recently announced its version of a paperless braille recorder - Versabraille. Similar to the Digi-cassette in braille

and audio recording and playback functions, Versabraille contains an additional feature - - a sophisticated micro-computer, which enables a user automatically to locate information stored on the cassette and to insert or delete materials after a cassette has been recorded. Versabraille will doubtless become a valuable addition to the developing repertoire of communication systems for blind people.

As devices, such as the Optacon, Digi-cassette, Versabraille, and the Kurzweil Reading machine, become available to more visually impaired individuals nationwide, these persons will begin to develop skills which are more compatible with the needs of their sighted employers. T. Cranmer of the Bureau for the Blind, Commonwealth of Kentucky has stated: "The problem of employment for the blind becomes most serious when we realize that literacy in braille is not usually an acceptable substitute for reading and writing print. . . braille falls short of the requirement of compatibility with the communication system in use by the employer." Although the problems of access to printed information and of the production of printed information in the desired format by the blind employee are increasingly being resolved with innovative equipment, T. Cranmer advised that, "before it will be possible to fully realize the potential of present and future technology as it applies to the employment of the blind, considerable attention will have to be given to training blind persons to use the devices, and to training counselors and placement specialists in job modification techniques." In addition, educators of teachers for the visually impaired should begin to incorporate hands-on experience with these devices in their teacher preparation programs. Skilled technologists should play a vital role

in any training program that realized the importance of technology for the future education of persons who are visually impaired.

To date, however, there is limited use of many of these developments in educational programs, due to the fact that their educational and vocational applications have not been fully explored. Adequate instructional materials and programs have yet to be designed. The Bureau of Education for the Handicapped, particularly its Division of Media Services, has been engaged in assisting with the development of many of these devices, particularly the Optacon and the Kurzweil Reading Machine. They are encouraging and facilitating the marketing of such equipment directly by the developers and also through such agencies as LINC Services. Parallel with the underwriting of developmental efforts of these kinds, some evaluation and software development projects have been supported. In particular, the Division of Media Services Field Initiated Research Program and the Division of Innovation and Development Field Initiated Research Programs provide opportunities to apply for funds to support the evaluation of instructional media, materials, and educational technology.

Systematic Evaluation of Presently Marketed Devices

The numerous technological developments discussed would seem to suggest that the situation has never been better for visually impaired persons with respect to availability of technological devices to mitigate persistent problems. Every technological development moves in some way either to improve or to complicate life for the visually impaired person. However, little is yet being done both to evaluate the expanding technology becoming available for the visually impaired, to explore optimum ways it can be used, and to disseminate it effectively to the potential users. Reviewing the

literature in relevant journals yields surprisingly few written reviews of equipment or equipment usage.

When there is little or no informative data published about a device one is contemplating using with students, it is the responsibility of the individual to ask pertinent questions about the device and to plan for its systematic appraisal.

In general, there are two types of questions one might ask about the equipment: subjective questions (e.g., "How do students like/dislike this equipment?") and objective questions (e.g., "How well do my students read/write/listen with this equipment in comparison with the standard methods used for reading/writing/listening?").

While answers to both types of questions are of value in the final decision of whether or not to continue using the equipment, they require different approaches to finding the answers.

Subjective questions are best answered through direct questioning or questionnaires and surveys. One simply chooses a questionnaire format (yes/no, multiple choice, open-ended, etc.) and decides which questions to ask. Distribution and administration of the form can vary, depending on population; and results are generally tabulated in chart or table format. Keeping a logbook for on-the-spot recording of equipment functioning is another quick way to keep track of problems that occur from day to day. Records of this nature are invaluable to the manufacturer or repairman when one has equipment serviced. Objectives questions about the performance of students using the equipment require a constant monitoring and data collection procedure which lasts a sufficient length of time for variables, such as learning effect, and novelty, to be accounted for.

While there exist numerous types of data collection schemes, any plan to monitor student progress should include 1) a testing procedure that is simple to use and that requires a minimum of time to administer and evaluate; and 2) testing materials which are novel, yet are at the students' grade level. It is very helpful to use a stopwatch or bell timer to keep the testing procedure to a four or five minute limit, or to keep track of the amount of time required for the student to perform the task. One should also attempt to check the students' performance on a regular basis, if possible daily, but more realistically, once or twice a week. Graphing or charting student performance will be helpful in monitoring student progress or lack of progress and in deciding whether or not modification of training procedures or additional training is necessary to improve performance. It is also very useful to keep a log of the student's behavior when s/he uses the equipment in question. Remarks concerning the student's mood or motivation which could significantly affect his performance are particularly important to record.

As an example, Ashcroft and Bourgeois (1979) and Bourgeois and Ashcroft (1979) have reported on the systematic evaluation of the Digi-cassette machine. In their study, student's oral reading performance was monitored in two conditions: 1) with conventional braille materials, and 2) with brailled cassette materials for use with the Digi-cassette. On a weekly basis, students were asked to read in each condition for five minutes. A word-per-minute score was calculated for each session and then charted on a performance graph. The number of reading errors per minute was also figured and charted. Comparisons of reading rate and reading error rate in the two conditions were then made.

Finally, one has a responsibility to share with other professionals in the field whatever data one can collect on student performance with new technology. Reporting at professional conferences and publishing in journals are the best means available through which to disseminate the valuable information one has collected in the field.

Technological advances are not made in a vacuum. New equipment has to be used and proven beneficial by the users in order for it to impact on the education and development of other users. More importantly, users have to demonstrate the advantages of the equipment over more traditional methods in their daily lives, in educational and vocational settings. Consequently, communicating equipment evaluation reports should be the responsibility of equipment users. This is particularly important in a field, such as technology for visually impaired persons, where the knowledge and experience of a few people could enhance the future experiences of others. As Robert Mann (1978) has stated, ". . .information on utility is so vital to user, agency, manufacturer, and researcher alike, and the need for objectivity in an evermore complex user equipment and societal system so pressing that we cannot escape or postpone evaluation except at out own peril." (p. 415)

References

Ashcroft, S. C., and Bourgeois, M. (1979) "Recent Technological Developments for the Visually Impaired: State of the Art". Paper presented at the Association for Special Education Technology Conference, New Orleans, LA., March, 1979.

Bourgeois, M., and Ashcroft, S. (1979) "Paperless braille reading: A preliminary research report". Paper presented at the 57th Annual Conference of the Council for Exceptional Children, Dallas, Texas, April, 1979.

Clark, L. L. (1963) Proceedings of the International Congress on Technology & Blindness, New York: AFB.

Cranmer, T., Personal Communication

Dupress, J. K. (1963) Summary of Proceedings of the International Congress on Technology and Blindness. In L. L. Clark (Ed.), Proceedings of the International Congress on Technology & Blindness. New York: AFB, p. 473-479.

Mann, R. (1978) Sensory Aids Evaluation: An Unmet Need? Journal of Visual Impairment and Blindness, Vol. 72 p. 415.

Appendix 17

Council for Exceptional Children Presentation Paper

Paperless Braille Reading: A Preliminary Research Report

M. Bourgeois, Research Associate
S. C. Ashcroft, Professor

George Peabody College for Teachers
Nashville, Tennessee

Paper presented at
The 57th Convention of
The Council for Exceptional Children
Dallas, Texas
April 22-27, 1979

Paperless Braille Reading: A Preliminary Research Report

M. Bourgeois, Research Associate
S. C. Ashcroft, Professor

Electronic and computer technology is beginning to make a larger and more pervasive impact on the education of visually impaired children than ever before. Instruments such as the Optacon, the Kurzweil Reading Machine, and paperless braille equipment should have a far-reaching and profound effect on these children. As educators, however, we have a duty and responsibility to these and future blind children to insure that the quality, practicality and reliability of new equipment that becomes available is not merely adequate, but that these devices will have a positive and beneficial effect on the educational performance of these children.

Fortunately, federal funding agencies are aware of the need to carefully evaluate new technological developments. This is a report on one such evaluation project funded by BEH, Division of Media Services; entitled "Evaluation and Research Program for the Portable Braille Recorder (or Digi-cassette)." While purposes of this project include 1) field testing the Digi-cassette in order to establish its potential as an educational aid for blind children, 2) determining user satisfaction, practicality, reliability, and maintainability of the Digi-cassette, and 3) studying braille

reading and writing performance with the Digi-cassette, this paper discusses the preliminary data collected on reading performance with the Digi-cassette.

The Digi-cassette is an electronic braille reading and writing machine, that uses audio cassettes instead of paper to store information.

(figure 1)

The user can prepare a text using the standard braille keyboard and later read it back on this 12-cell or a 20-cell display. When reading a text, the user simply turns on the machine and presses the transfer button to advance the tape. When information in braille appears, the first 12 cells of the text pop up out of the display. The user can then read them and when finished, simply touch the touch switch to read the next 12 cells. In this manner, the user can control the rate at which he reads the braille cells. Theoretically, this machine has the potential of alleviating the imbalance in supply and demand for conventional braille volumes, to say nothing of the cost reduction and space-saving features of audio cassettes as opposed to braille books.

However, several of the Digi-cassette's unique features warrant investigation. The most obviously different features of this equipment are the 12-cell braille reading line, and the touch switch. These two factors often require major changes in braille readers' reading habits. For example, while it is not unusual for the blind child to use the three middle fingers of both hands to read a braille volume, the

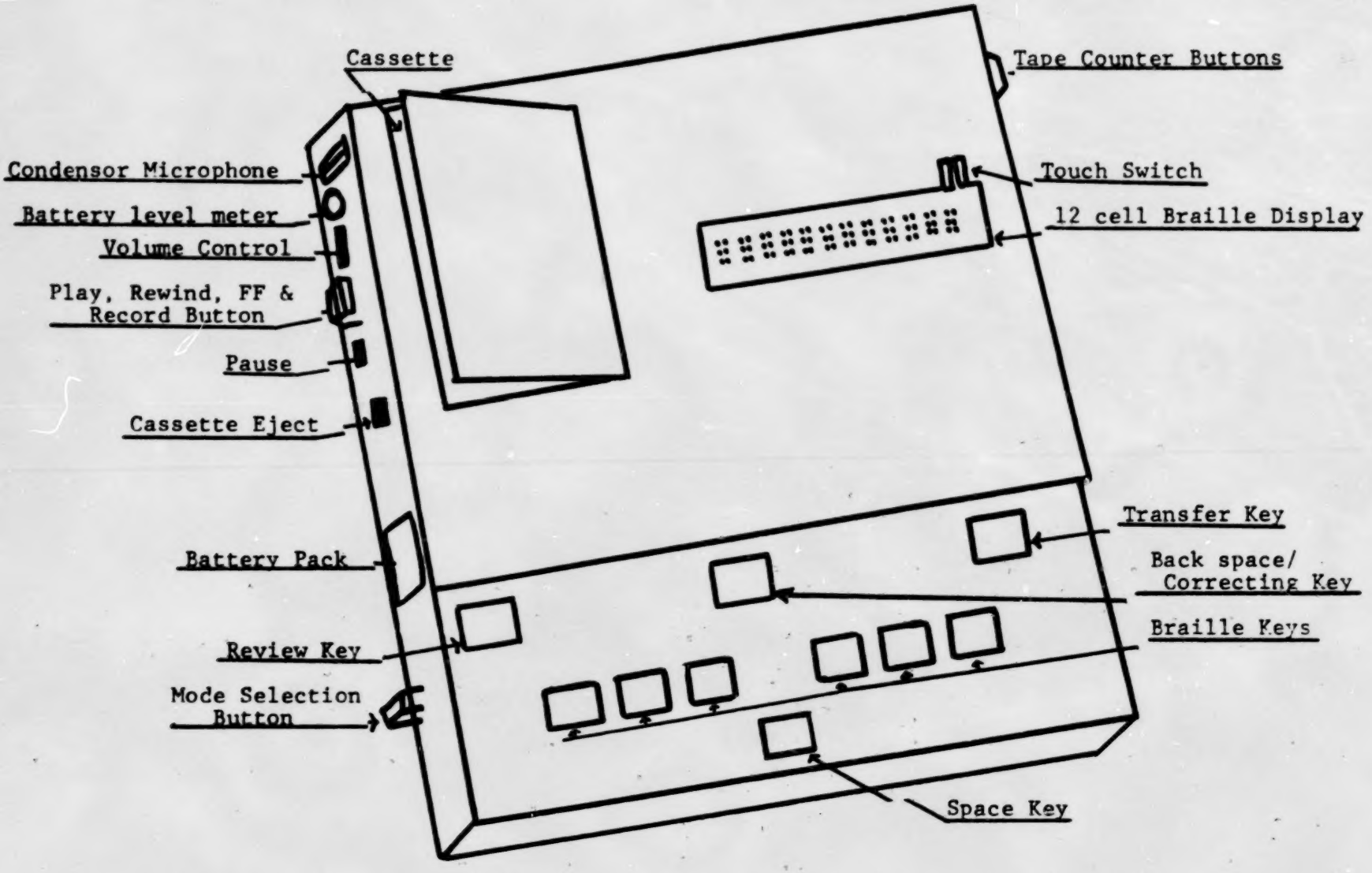


Figure 1. Digi-cassette Schematic

the same child has to limit himself to one, or at best, two index fingers when reading the Digi-cassette. This in part, is due to the sensitive nature of the touch switch, which is a simple circuit requiring only the slightest touch of a finger to be completed and to change the line of braille.

The 12-cell display can also cause problems for the reader. For example, when a word does not fit in entirety within the 12 cells, the word is broken indiscriminately at the letter filling the 12th braille cell, and the remainder of the word's letters appear on the next line. No hyphens appear when this occurs. As a result, the probability of reading errors increases. An isolated "s" symbol in the 12th cell is easily read as so, whereas it could just as likely be the first letter of the word "sailor."

Therefore, it is of interest to know how well students can read braille using the Digi-cassette when they are required to adapt to a 12-cell reading line and to a sensitive touch switch. It is also of interest to discover whether or not the students' reading errors will increase as a result of using the Digi-cassette. The purpose of the following study was to establish oral reading rates and oral reading error rates for subjects reading conventional braille volumes and brailled materials with the Digi-cassette. Statistical treatment and graphical representation of the data will demonstrate trends in student performance. Comparisons of reading rate and reading error rate performance in two reading modes (conventional braille vs. braille on Digi-cassette) will be made.

Method

Subjects

Presently Digi-cassettes have been placed with three blind elementary school children in local day schools, six high school students from the residential school for the blind, and four blind college students at George Peabody College. These participants were chosen on the basis of their desire to learn to use this equipment for note-taking in their classes; all participants were braille readers. Each elementary and high school aged participant received an average of four hours of orientation and instruction with a staff member, after which a criterion-referenced proficiency test was administered. A score of 90% or better on this test insured that the child had mastered the operations of the Digi-cassette.

College students required no more than one hour of orientation and instruction to become proficient in operating the Digi-cassette.

Procedures

Data collection activities proceeded in the following manner. During four 1 hour sessions in which subjects were instructed in the operations of the Digi-cassette, five minute audio-recordings were made of the subjects reading from novel junior/senior high school level reading materials in braille. A word per minute score for each session was calculated for each subject by taking the mean of the five 1-minutes samples.

A criterion referenced proficiency test was administered to each subject during the fourth session. A score of 90% or better insured that the subject could operate the Digi-cassette and could successfully troubleshoot equipment malfunctions.

After obtaining a 90% score or better score on the criterion-referenced test, oral reading rates were established using the Digi-cassette and pre-recorded braille cassettes during weekly assessment sessions. The mean of five 1-minute timed intervals was calculated for a word per minute score. Oral reading was tape recorded and later transcribed in order to establish reading rates and reading error rates. Reading error rates for each subject were calculated from the reading samples. A reading error was defined as any incorrect repetion, self-correction, incorrect word, or unread continuous portions of the text. The reading materials used were novel junior high graded reading passages, such as Island of the Blue Dolphin and Little Women.

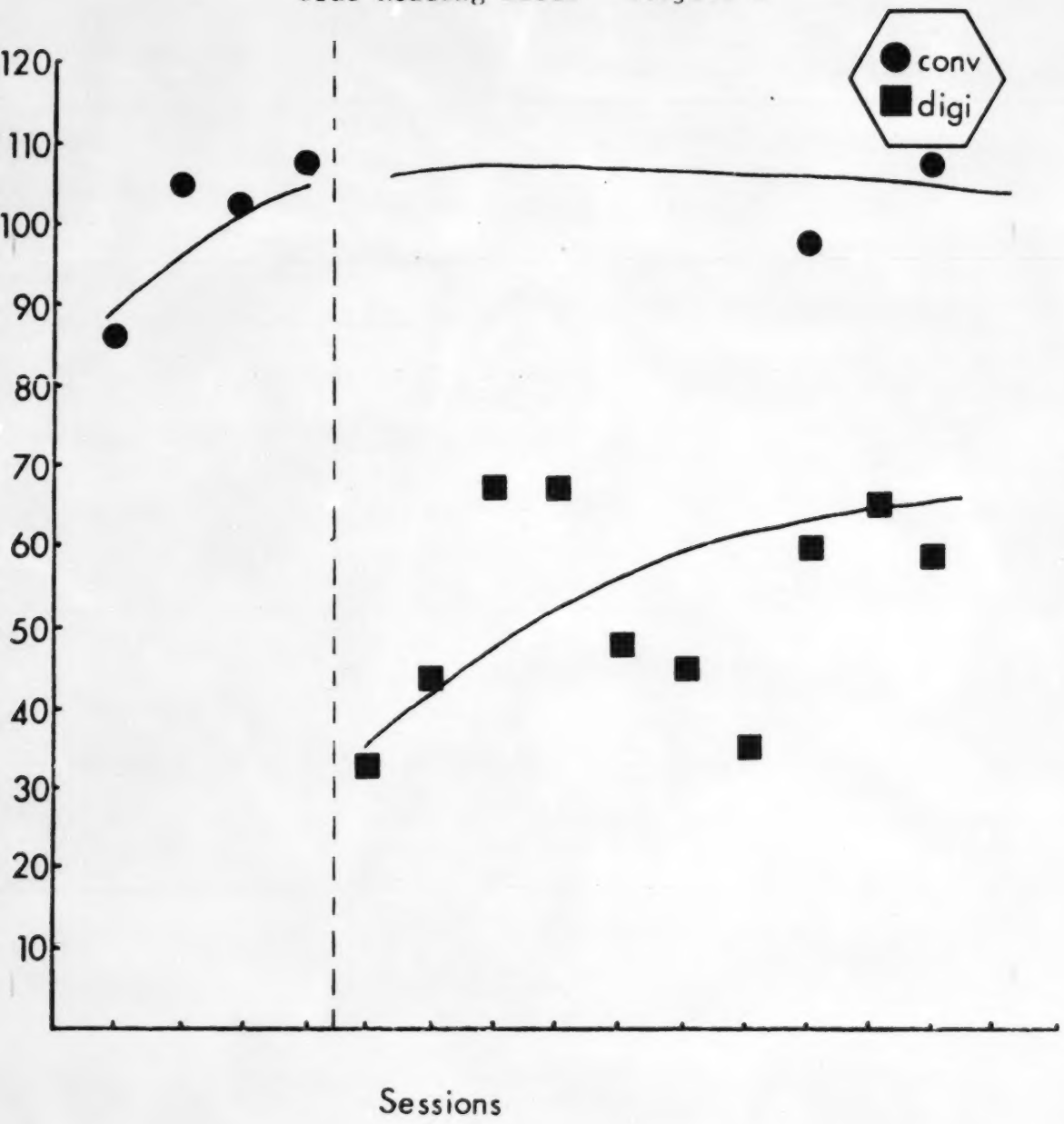
Subjects contracted with the staff for the length of time they served as participants. After their contracts had expired, each student was asked to answer detailed questionnaires about the Digi-cassette's functions and their own satisfaction with it.

(figure 2)

Results

Figure 2 is a graph of subject 1's reading performance with conventional braille books (conv. - circles) and with

Figure 2
Oral Reading Rates - Subject 1

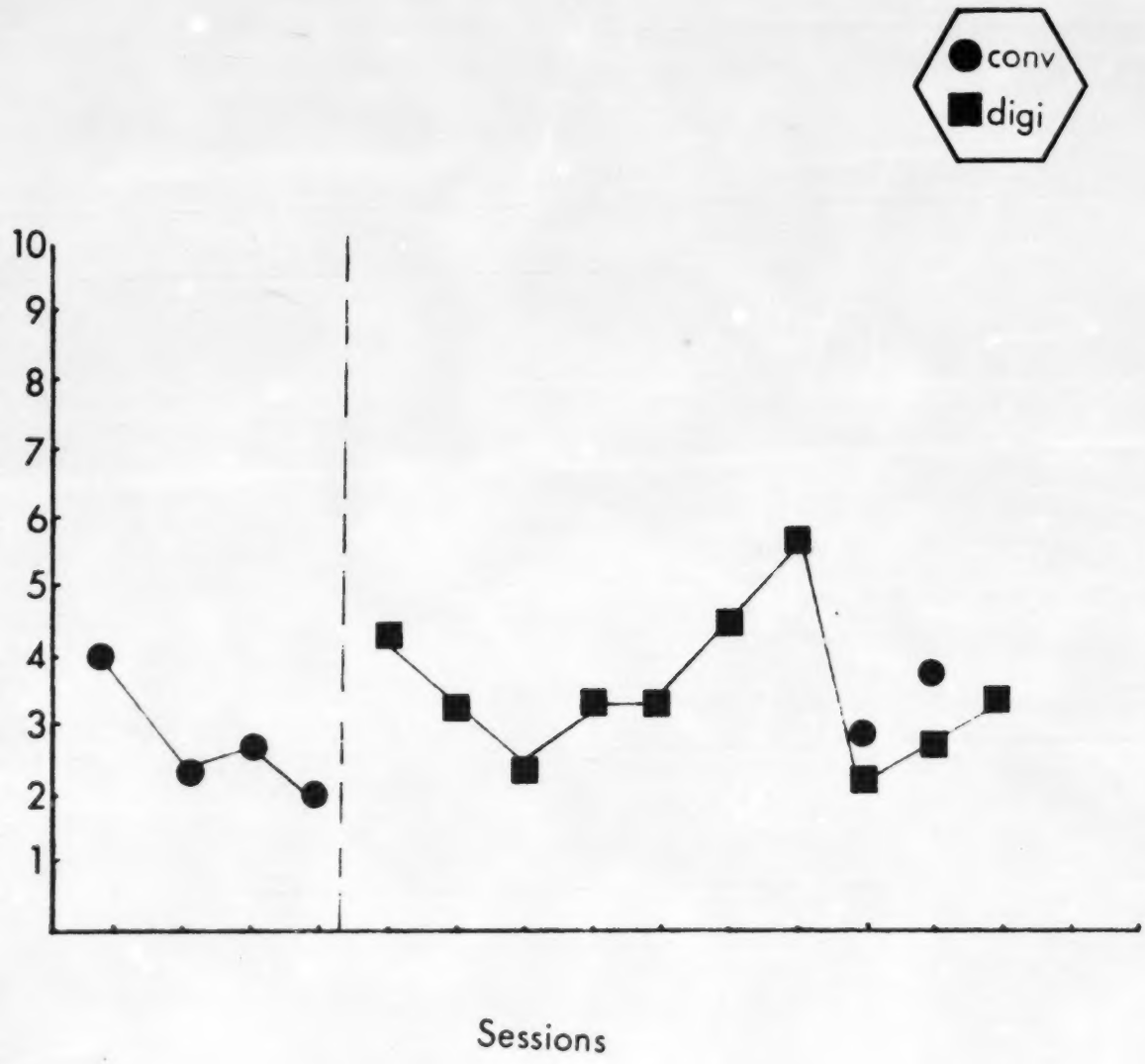


Digi-cassette braille tapes (digi- squares). The first four data points represent the number of words per minute read with conventional braille during the instructional (or baseline) period. The dashed line represents administration of the criterion-referenced proficiency test. Squares represent word per minute scores for oral reading with the Digi-cassette. Notice that subject 1's oral reading rate with the Digi-cassette (approximately 60 wpm) is consistently slower than his reading rate with conventional braille (approximately 105 wpm). The positive trend in the Digi-cassette reading rate scores would lead one to predict insignificant differences between reading rates in the two reading modes in time.

Figure 3 represents the reading error rate for the two reading modes. Again, circles represent the mean of five 1-minute conventional braille reading samples and the squares represent Digi-cassette reading samples. Notice the similarity in reading error rates between the two modes: with conventional braille the range of errors per minute is 2 to 4 and with Digi-cassette braille the range is 2 to 5.5 errors per minute.

Because the six high school subjects demonstrated results similar to those of subject 1, the data for these seven subjects were grouped. Figure 4 represents the preliminary grouped data for oral reading rates. As shown in Figure 2, reading rates with conventional braille are consistently

Figure 3
Oral Reading Error Rates - Subject 1



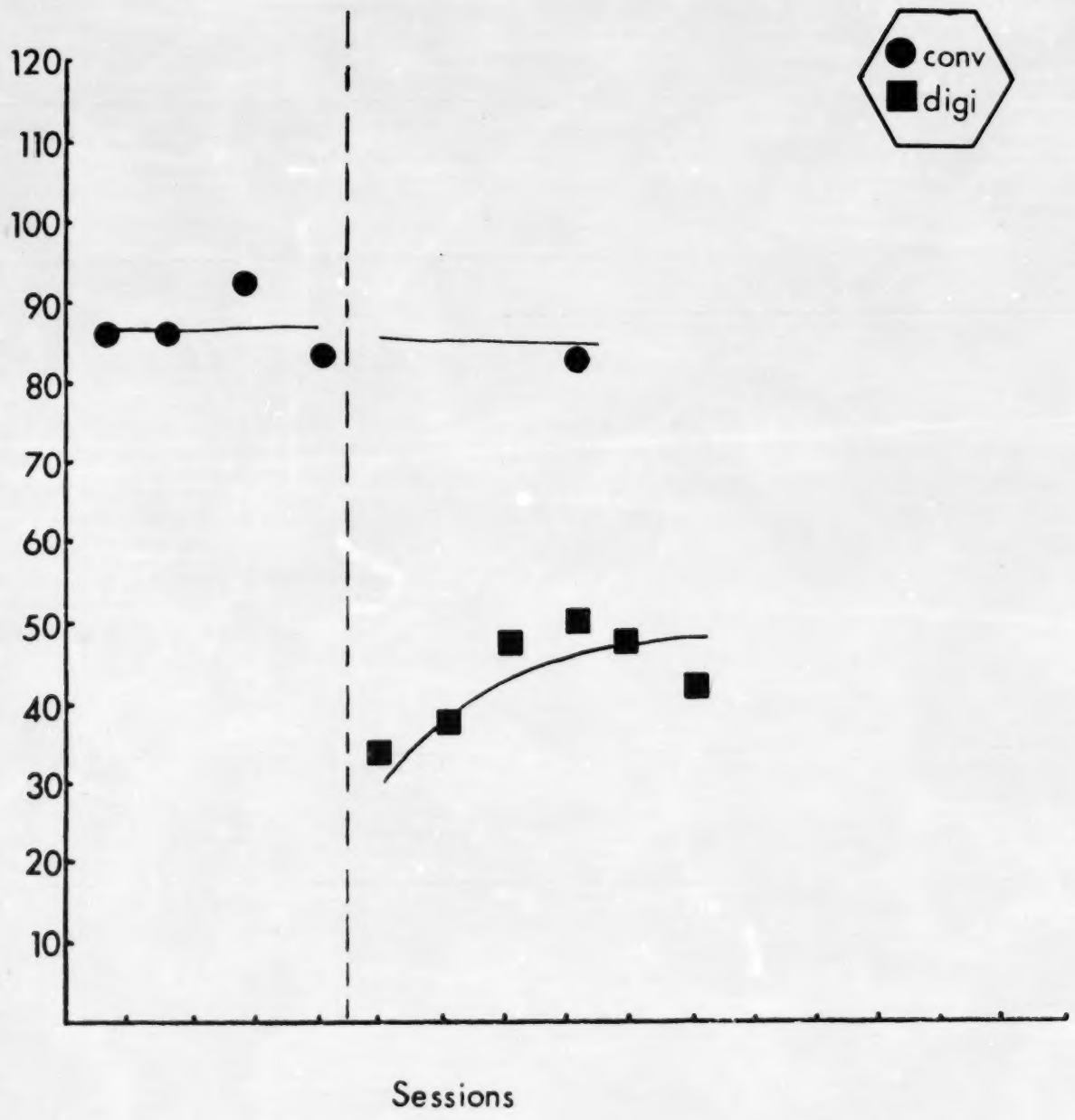


Figure 4
Oral REading Rates: Group Data, N=7

faster (approximately 90 wpm) than reading rates with the Digi-cassette (approximately 50 wpm). The oral reading performance with the Digi-cassette, as shown in Figure 4, demonstrates a positive trend. However, the considerable difference in performance between conventional braille reading and braille reading with the Digi-cassette suggests the need for improving braille reading with the Digi-cassette.

Figure 5 represents the oral reading error rate grouped data for the two reading modes. Again, notice the similarity in error rate performance between the two reading modes. The range in error rate for conventional reading is 1.8 - 2.4 errors per minute, while the range for reading with the Digi-cassette is 1.8 - 2.9 errors per minute. Although statistical tests have not yet been run, significant differences are not anticipated to be established.

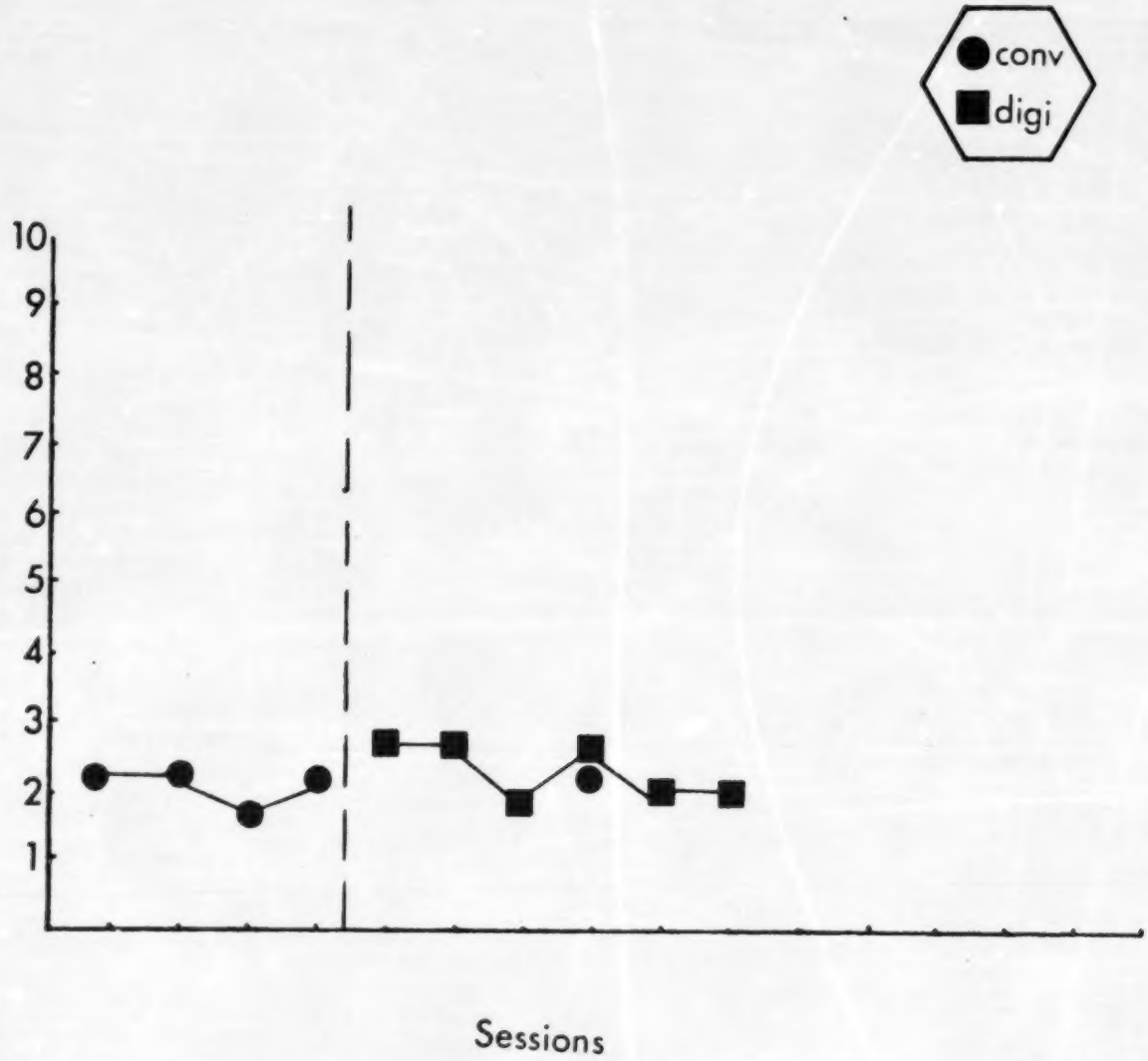
Discussion

These data suggest several points:

1. Reading with the Digi-cassette is slower than reading conventional braille. Subjects consistently read 30-50 wpm slower when reading with the Digi-cassette.

2. The similarity in reading error rates between the two reading modes suggests that the mechanical features of the Digi-cassette and the problem of "broken" words at the end of a line, are not causing significant numbers of errors to occur. Because of the nature of the Digi-cassette, subjects may be slowing down their reading rate, as demonstrated by their reading rate performance, in order to compensate for the

Figure 5
Oral Reading Error Rates: Grouped Data, N=7



adjustments made in their reading style due to the Digi-cassette. As a result of their slower reading rate, subjects may be committing fewer actual reading errors, yet enough machine handling error for the total number of errors to be similar to the errors committed when reading conventional braille. Reading transcripts need to be examined further to categorize the actual types of errors committed in reading.

3. Low oral reading rates with the Digi-cassette may be accounted for 1) by lack of experience with the Digi-cassette (3 months for Digi-cassette vs. 8-10 years for conventional braille), 2) by modification in personal reading style (from coordinated two handed reading to one handed reading) or 3) by increased memory load for past words or letters due to the nature of the 12-cell braille line. Further research is needed to test these hypotheses.

This study was designed to establish the differences in oral reading rates between the two reading modes when subjects received only informal instruction in reading the 12-cell display. Perhaps a reading program could be developed which would improve reading rate scores for a 12-cell braille line.

In conclusion, the data reported today are only preliminary data. Further compilation of data and statistical treatment of the data are necessary before a definitive statement of the results can be suggested. It is hoped that other researchers and educators will use this research model to collect performance data for students using equipment such as the Digi-cassette, Versabraille, Optacon and others.

These data will then be useful in the modification of equipment and in the design of educational programs which will be bnenfical to visually impaired students.

Criterion-Referenced
Proficiency Test for Operating PBR

Identification of Parts

+ correctly identified
X = incorrectly identified

1. Where is the front of the machine?
2. Where is the top of the machine?
3. Show me the cassette holder.
4. Show me the braille display.
5. Show me the touch control.
6. Show me the braille keyboard.
7. Show me the backspace/correcting key.
8. Show me the review key.
9. Show me the transfer key.
10. On the left side of the machine, show me the mode selector button.
11. Show me how to record.
12. Show me how to fast forward.
13. Show me how to rewind.
14. Show me the cassette eject button.
15. Show me the volume control.
16. Show me the pause button.
17. Show me the microphone.
18. Show me the battery level meter.
19. Show me the battery pack.
20. On the right side, show me the counter button.
21. Show me the counter erase button.
22. On the back side, show me where you plug in the battery charger.

Utilization of the Machine

Reading a Braille Tape

1. Insert cassette.
2. Put mode selector button in "out" position.
3. Rewind tape to beginning.
4. Turn machine vertically.
5. Push in tape control.
6. Return machine to horizontal position.
7. Press transfer key.
8. Press review key.
9. Repeat steps 7 and 8 until braille appears.
10. Read braille.

Typing Braille

1. Insert cassette.
2. Put mode selector button in "out" position.
3. Fast forward tape past leader tape.
4. Push in tape control.
5. Type 116 braille characters plus four more.
6. Press transfer key to record on tape.

Correcting a Mistake

1. Press backspace key until incorrect letter disappears.
2. Type the correct letter.
3. Touch the touch control twice to read the corrected line.

Fast Forwarding a Tape

1. Pull tape control button toward you.
2. Hold button there.
3. Press transfer key.
4. Release at desired place.

Rewinding a Tape

1. Push tape control button away from you.
2. Return to neutral position at desired place.

Setting the Tape Counter

1. At beginning of tape, press both buttons to set counter at "000".
2. To indicate your place in a text, push the top button--numbers appear.
3. To clear the numbers, push bottom button.

Audio Recording

1. Push mode selector button "in".
2. Machine remains in horizontal position.
3. Push in tape control--machine is recording.

Audio Playback

1. Push mode selector button "in".
2. Turn machine vertically.
3. Push in tape control button.
4. Return machine to horizontal position--machine playing.

Problems

What do you do if:

1. A loud, continuous high-pitched sound occurs.
   a. First, press review key, if nothing happens. . .
   b. Turn machine off and then on, . . .
   c. Battery needs to be charged, plug in battery charger.

2. There appears to be no braille on your tape?

   a. Fast forward the tape to find it.

   b. Turn tape to the other side.

   c. Test the tape in the audio mode.